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ABSTRACT

General and specific safety procedures and recommendations for secondary school science laboratories are provided in this guide. Areas of concern include: (1) chemicals (storage, disposal, toxicity, unstable and incompatible chemicals); (2) microorganisms; (3) plants; (4) animals; (5) electricity; (6) lasers; (7) rockets; (8) eye safety and protective eye devices; (9) equipment producing ionizing radiation; and (10) radioisotopes. Pertinent Pennsylvania laws are cited for appropriate areas. An appendix contains various items pertaining to laboratory safety considerations including lists of non-recommended chemicals, carcinogens and their synonyms, lists of radioisotopes and their sources, and rules and regulations of the United States Nuclear Regulatory Commission. (JN)

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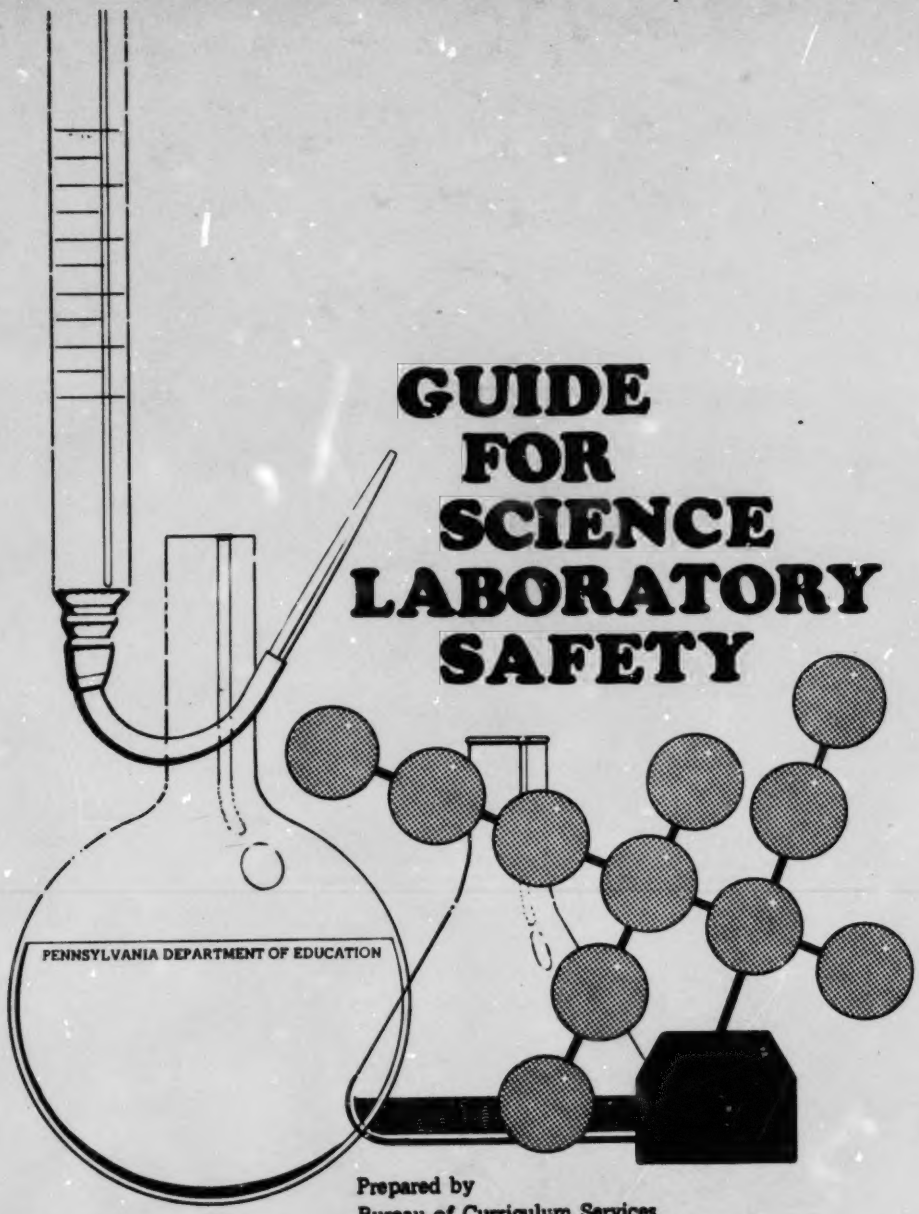

GUIDE FOR SCIENCE LABORATORY SAFETY

Prepared by
Bureau of Curriculum Services
Pennsylvania Department of Education
1981

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GUIDE FOR SCIENCE LABORATORY SAFETY

I. General Safety Procedures for the Science Laboratory

It is recommended that science teachers observe the following safety procedures:

1. Periodically review with the students the condition and proper location and use of safety devices such as fire extinguishes, safety showers, first aid kits, fire blankets and eyewashes.

2. General good housekeeping procedures should be adhered to, with emphasis upon the proper maintenance and storage of chemicals and equipment.

3. Students should be made fully aware of fire precautions, accident procedures, and evacuation routes.

4. The instructor should strictly follow federal, state, and local regulations relating to school and laboratory safety.

5. Laboratories should be provided with chemical spill packages, metal containers for the disposal of broken glass, and a sand-filled container for the disposal of matches.

6. Laboratories should be equipped with main shut-off values and switches for water, gas and electricity.

7. Hazardous materials should be maintained under lock and key at all times. Maintain minimum amounts of chemicals in the classroom.

8. Lock all laboratory and storage facilities when they are not under direct supervision.

9. Label and date all reagent bottles.

10. Protect your students against poisoning by providing adequate ventilation for volatile substances, and by providing instruction on the avoidance of ingestion of chemicals or plants.

11. Provide adequate shielding when performing demonstrations where the dangers of explosion, implosion or spattering of chemicals exists.

12. Always stress safety in demonstrations or student experiments.

13. Provide sufficient time for students to set up equipment, perform the experiment, and properly clean up and store equipment and chemicals after they are used.

14. Instruct students concerning specific hazards and precautions at the beginning of each experiment.

15. Instruct students never to eat or drink in the laboratory and never to use laboratory glassware as food or drink containers.

16. Demand that chemicals goggles be worn at all times in the laboratory. This is required by Pennsylvania law. (Act 116 of 1965).

17. Instruct students never to perform an unauthorized experiment or to use unauthorized equipment or materials.

18. Caution students to exercise care in noting odors. Insist that they never taste, touch, or smell substances without specific instructions from the teacher.

19. Never pipitte chemical reagents by mouth.

20. Instruct students concerning the proper procedures and precautions involved in inserting glass tubing into a rubber stopper.

21. Instruct students to always slant test tubes away from themselves and/or other persons when heating them.

22. Do not allow students to discard matches or other insoluble material in sinks.

23. Insist upon caution regarding long hair or loose clothing, especially when using sources of open flame such as burners.

24. Insist that students wear laboratory aprons or coats when working in the laboratory.

25. Do not allow open shoes or sandals in the laboratory.

26. Discourage students from wearing contact lenses in the chemical laboratory because of the dangers involved in case of chemical splashes or volatile substances.

27. Do not allow students to keep materials other than laboratory notebooks in the work area.

28. Caution students that it is unsafe to touch the face, mouth or eyes or any other area of the body after working with plants, animals or chemicals until they have thoroughly washed their hands.

29. Provide adequate supervision of the laboratory at all times.

II. Some Specific Safety Procedures Regarding Chemicals

A. Chemical Storage

Proper chemical storage should prevent unauthorized removal of chemicals, protect the school environment from excess chemical emissions, and provide protection from fire.

The chemical storage room should be well ventilated, protected from sunlight and localized heat sources, and dry. It should always be kept locked when not in use. The following precautions should be taken:

1. Flammable liquids (includes gasoline, kerosene, methyl acetate, alcohols, ketones, petroleum ether, pyridine, toluene, turpentine, xylene).

   Store in safety cans not larger than one gallon capacity. Place in a separate metal cabinet.

2. Oxidizers (includes ammonium nitrate, potassium nitrate, potassium permanganate, sodium nitrate, metallic sulfates or permanganates).

   Keep in a locked, light free metal cabinet.

3. Remainder of the chemicals.

   Provide controlled storage, providing special handling where required by the nature of the substance.

   a. Metallic sodium or potassium must be stored under kerosene.

   b. Do not store containers of sodium, potassium or calcium on shelves *above* aqueous solutions or containers of water.

   c. Store and cut white phosphorus under water. Change the water occasionally as it becomes acidic.

4. Ether (Diethyl ether)

   Ether requires special care for its storage and use. Ether slowly reacts with atmospheric oxygen to form explosive peroxides. These unstable peroxides tend to concentrate because they are less volatile than the ether from which they were formed. We recommend that ether should be purchased in small quantities and discarded within six months after the container has been opened.

5. Refrigerator Storage of Chemicals

   Ether or other flammable or explosive substances should only be stored in laboratory - type spark and explosion - proof refrigerators. Home-type refrigerators are not suitable for this type of storage because they have numerous open - type switches which may spark and ignite any flammable or explosive vapors present.

6. Storage of Chemicals in Fume Hoods

   Chemical fume hoods are not designed for storage of volatile or flammable reagents, and should not be used for this purpose. Hood ventilating systems are not designed for continuous operation. A corrosive atmosphere may develop, causing the loss of labels. Hoods do not provide security for chemicals. Any use of a hood for storage should be discouraged.

B. Chemical Disposal

Small amounts of dilute acids, bases or salts may be flushed down the drain with large amounts of water, but care should be taken to be certain that all chemicals disposed of in this manner are water soluble, non-toxic, and in low concentrations.

Toxic or insoluble solids should be disposed of in crockery storage jars with lids. The contents should be disposed of following proper procedures.

Following is a partial list of materials which can be disposed of in a land fill or released to the air:

Argon
Asphalt
Batteries, Dry Cell
Boron
Bromochloromethane
Calcium Carbonate
Calcium Oxide
Carbon Tetrafluoride
Chromium
Crude lime
Dichloromethane
Epoxy resin systems
Ferrosilicon
Helium
Hexachloroethane
Hexafluoroethane
Hydrogen
Latex
Magnesium Oxide
Metal Scrap
Molybdenum, insoluble compounds
Neon
Nitrogen
Nitrogen trioxide
Osmium tetroxide
Oxygen
Ozone
Pyrethruum
Silica
Sulfur
Sulfur hexafluoride
Tetrabromomethane
Tin, organic compounds
Titanium oxide
Trifluormethane
Urea
Zinc Oxide

Other compounds should be disposed of using the services of a licensed chemical disposal company.

The following chemical disposal companies are licensed to operate in Pennsylvania. The inclusion of their name and address in this publication is for information only and does not imply an endorsement or recommendation by the Department of Education.

Ecology Chemical and Refining Co.
Brush Creek Road and Penn Street
Manor, PA 15665
Telephone: (412) 864-5237 *or*
(412) 661-3434

Reclamation Services, Inc.
2042 Lenhart Road
Lansdale, PA 19446
Telephone: (215) 368-3100

U. S. Utilities Services Corp.
470 Mall Circle Drive
Monroeville, PA 15046
Telephone: (412) 373-1370

Waste Conversion Co.
2869 Sandstone Drive
Hatfield, PA 19440
Telephone: (215) 822-8996

Resource Technology Services, Inc.
6 Berkely Road
Devon, PA 19333
Telephone: (215) 687-4592

C. Chemical Toxicity

Toxic chemicals may be classed as nuisances, irritants, corrosives, anaesthetics, allergens, carcinogens, mutagens, teratogens, toxins, and central nervous system depressants. Chemical entry occurs through the digestive tract, respiratory tract, or skin. The respiratory tract is the most common entry pathway.

1. A partial list of substances whose fumes or dust are toxic when inhaled is as follows:

Acetic Acid (concentrated)
Ammonuim hydoxide
Benzene
Bromine
Carbon disulphide

Carbon monoxide
Carbon tetrachloride
Chlorine
Formic acid
Hydrochloric acid
Hydrofluoric acid
Hydrogen sulfide
Iodine
Mercury
Nitric Acid
Nitrogen Oxides
Plastics (especially fumes when burning)
Perchloric acid
Potassium hydroxide
Sodium Hydroxide
Sulfuric Acid
Sulfur Dioxide

2. Skin contact with some chemicals should be avoided because of possible tissue damage or because of the ability of some toxic substances to penetrate the skin. Following is a partial list of substances which should be kept from contact with the skin:

Bromine (liquid)
Carbon tetrachloride
Chromates
Dichromates
Formic acid
Hydrochloric acid
Hydrofluoric acid
Iodine
Mercury
Nitric acid
Phosphoric acid (hot concentrated)
Potassium hydroxide
Sodium hydroxide
Sulfuric acid
Methyl alcohol
Butyl alcohol
Methyl acrylate
Perchlorethylene
Carbon disulfide
Benzene
Pesticides (nearly all)

3. Other chemicals are known to cause cancer. In the appendix are two articles distributed by the Department concerning such carcinogenic chemicals.

N.B.: These are the only chemicals that we strongly recommend be eliminated from use in the school laboratory. All other lists of chemicals can be safely used with the proper precautions.

4. Following is a partial list of unstable chemicals.

   a. Ether - forms unstable peroxides. Discard after six months.

   b. Ammonium nitrate - decomposes exothermically above 160°C producing a large volume of gasious products.

   c. Formic acid (concentrated) may explode.

   d. Phosphorus (white) - Spontaneously ignites in air at temperatures above 30° c.

   e. Ammonaical silver nitrate solution (Tollen's reagent) - may detonate violently when disturbed.

   f. Benzoyl perodixe - extremely unstable

   g. Nitrogen triiodide - Shock sensitive when dry

   h. Picric acid (or metal picrates) - very unstable

5. Some chemicals are incompatable, producing violent reactions. Following is a partial list of chemicals which should never be allowed to come together.

Compound	Incompatable with
Acetic acid	Nitric acid, peroxides, permanganates, ethylene glycol, hydroxyl compounds
Acetone	Concentrated nitric and sulfuric acid mixtures
Alkali metals (e.g. sodium potassium)	Carbon tetrachloride, carbon dioxide, water, halogenated hydrocarbons
Ammonia, anhydrous	Mercury, chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid
Ammonium nitrate	Acids, flammable liquids, metal powders, sulfur, chlorates, any powdered organic or combustable substance
Aniline	Nitric acid, hydrogen peroxide.
Bromine, chlorine	Ammonia, petroleum gases, hydrogen, sodium, benzene, finely divided metals.
Chlorates	Ammonium salts, acids, metal powders, any powdered organic or combustable substance

Chromic Acid	Acetic acid, naphthalene, camphors, glycerine, turpentine, alcohol, any flammable liquid.
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
Hydrocarbons (propane, benezene, gasoline, etc)	Fluorine, chlorine, bromine, sodium peroxide.
Hydrogen peroxide	Metals, metallic salts, alcohols, organic substances, flammable substances
Hydrogen Sulfide	Oxidizing gases, fuming nitric acid.
Iodine	Acetylene, ammonia, hydrogen
Mercury	Acetylene, ammonia
Nitric acid (con.)	Acetic acid, hydrogen sulfide, inflammable liquids and gases
Oxalic acid	Silver, mercury
Potassium chlorate	Acids, any organic substances
Potassium permanganate	Sulfuric acid, glycerine, ethylene glycol
Sodium nitrate	Ammonium salts
Sodium peroxide	Ethanol, methanol, glacial acetic acid, carbon disulfide, glycerine, ethylene glycol, ethyl acetate.
Sulfuric acid	Potassium chlorate or perchlorate, potassium permanganate, similar compounds of light metals

III. SAFETY PROCEDURES WHEN WORKING WITH MICROORGANISMS

1. The teacher and students should follow the same general safety procedures as in any science laboratory, but they should be aware of the additional hazard presented by the possible presence of infectious agents.

2. High school students should not work with known pathogens. However, all microcultures should be treated as though they were pathogenic.

3. The most common sources of accidential microbial infection occur from oral aspiration from pipettes, accidental syringe inoculation, animal bites, spray from syringes, centrifuge accidents, cuts from contaminated glassware, spilling or dropping cultures, breathing of aerosols, and contact with infected animals or their cages. Laboratory procedures that minimize these dangers should be strictly followed.

4. The transfer or inoculation of cultures using a pipette should be accomplished with a bulb.

5. If pipetting by mouth is absolutely necessary, a cotton plug should be placed between the liquid and the mouth piece and the pipette should be attached to a length of clean rubber or plastic tubing.

6. In order to minimize the production of infectious aerosols, the pipette should always be discharged below the surface of liquids. Never bubble air into a liquid or forcefully eject the liquid from the pipette.

7. Used pipettes should immediately be placed in a disinfectant solution and autoclaved before reuse.

8. Microbiological experiments using live animals should be discouraged.

9. When using an inoculating loop, allow the loop to cool before insertion into the medium in order to avoid aerosal production. Avoid sudden movements which break the film loop.

10. Inspect all centrifuge tubes before use to guard against breakage. If breakage should occur, fill the centrifuge cups with disinfectant as a precaution.

11. When sampling for microorganisms to inoculate cultures, be aware of the possible presence of tetanus in soil and typhoid, botulism, and schistosomiasis organisms in standing water.

12. Do not contaminate cultures by coughing or sneezing. Minimize culture exposure to air.

13. Culture dishes should be taped closed before being passed around the classroom.

14. In case a culture is accidentally spilled, clean the area with a strong disinfectant.

15. Autoclave all old cultures before disposal.

16. Do not rely upon liquid disinfectants for complete sterilization. Autoclave.

IV. SAFETY PROCEDURES WHEN WORKING WITH PLANTS

1. All plants have not been thoroughly researched relative to their toxicity. When working with plants never place any part of the plant in your mouth or rub the sap or fruit juice on the skin or into an open wound.

2. Avoid inhalation or exposure of the skin and eyes to the smoke from any burning plant or plant part.

3. Do not pick or handle plants unknown to you.

4. Following is a partial list of plants known to cause reactions.

Apple - seeds
Autumn crocus - bulbs
Baneberry - berries
Black locust - bark, sprouts, foliage
Bleeding heart (Dutchman's breeches) - foliage, roots
Buttercup - all parts
Castorbean - seeds
Crab apple - foliage, seeds
Daphne - berries
Death camas - all parts
Dieffenbachia - all parts
Elderberry - all parts except fruits
Elephant ear - all parts
English holly - berries
Foxglove - leaves
Honeysuckle - seeds
Horsechestnut - leaves, flowers and seeds
Hyacinth, Narcissus, Daffodil - bulbs
Iris - underground stems
Jack-in-the-Pulpit - all parts
Jessamine - berries
Lantana (red sage) - green berries
Larkspur - young plant, seeds
Laurels, Rhododendron, Azaleas - all parts
Lilly of the Valley - leaves, flowers
Maidenhair trees (Ginko biloba) - fruits
Marsh marigold (uncooked) - all parts, sap
Mayapple - green apple, foliage, roots
Mistletoe - berries
Monkshood (Wolfbane) - fleshy roots
Moonseed - berries
Mushrooms - all parts
Nightshade - all parts, especially the unripe berry
Nettles - all parts
Oak trees - foliage, acorns unless prepared properly.
Oleander - leaves, branches
Peach - leaves
Pear - leaves
Plum - leaves
Poinsettia - leaves

Poison oak - all parts
Pokeweed - berries and roots
Potato - Vines, foliage, green tubers
Privet, common berries and leaves
Rosary pea - seeds
Rhubarb - leaf blade
Toadstools, other fungi - all parts
Tomato - vines, foliage
Water hemlock - all parts
White snakeroot - foliage
Wild carrot - foliage
Wild cumcumber - seeds
Wild (and cultivated) Cherry - twigs, foliage
Wild radish - flowers, fruits, stalks
Wisteria - seeds, pods
Yew - all parts

V. RECOMMENDATIONS AND SAFETY PROCEDURES WHEN WORKING WITH ANIMALS

1. An adult supervisor should assume the primary responsibility for the care and general welfare of animals.

2. All animals in the classroom must be lawfully acquired and kept in strict compliance with federal, state and local laws and regulations.

3. All animals must receive humane treatment.

4. Animals should be caged in order to avoid animal bites to students and to protect the animals from improper handling by students.

5. Be aware of and insist upon proper handling procedures and protective gloves and/or clothing. Follow special handling requirements if the animal is pregnant, with young, or hungry.

6. Promptly treat any scratches or bites and isolate the animal for 10 days.

7. Animal care facilities should be cleaned frequently to remove anumal wastes, control vermin, and keep pathogenic organisms at a minimum.

8. Maintain optimum housing conditions for each species including proper diet and sufficient fresh water.

9. Reptiles such as snakes and turtles should be handled as little as possible, and the hands should be thoroughly washed after handling them. Reptiles are potential carriers of salmonella.

10. Poisonous snakes, snapping turtles disease - carrying insects and harmful spiders should not be kept in the classroom.

11. No animal should be subjected to stress, pain or discomfort.

12. Nutritional deficiency experiments should be conducted only to the symptomatic stage and should cease before debilitating the animal. The animal should then receive a special diet to speed its recovery.

13. No sugery should be performed on any living vertebrate.

14. Obtain all animals from a reputable supply house. Do not bring wild animals into the classroom.

15. Any animal showing signs of disease should be isolated, its quarters disinfected, and if the diseased condition persists, humanely destroyed out of sight of the students

VI. SAFETY PROCEDURES IN WORKING WITH ELECTRICITY

The severity of electrical shock is determined by the amount of current which flows through the body. So, severe shock hazards may exist even when voltages are relatively low. Conditions which allow more than 10 milliamps to flow through the body will cause a powerful shock. A flow of from 100 to 200 milliamps may cause severe burns and unconsciousness. Conditions resulting in a current flow above 200 milliamps may be fatal.

1. Electrical circuits and equipment should only be handled with dry hands.

2. Electrical equipment should not be handled on a wet or on a metallic floor.

3. Test all electrical equipment for breakage. Do not use equipment which produces even a slight shock.

4. Shield all live electrical switches and connections.

5. Be aware of the main breaker for laboratory circuits.

6. Do not touch circuit parts with the power on.

7. Only use tools with insulated handles.

8. Check all circuits used by students before current is allowed to flow.

9. When assembling circuits connect the live portion last; when disassembling disconnect the live portion first.

10. When plugging in equipment beware of sparks from a possible short circuit. When removing plugs pull by the plug, not the cord.

11. Make certain that all electrical appliances and equipment are properly grounded.

VII. GENERAL INFORMATION AND SAFETY PRECAUTIONS INVOLVING THE USE OF LASERS IN SCHOOLS

The increased use of lasers in science classes may pose a potential hazard to students and teachers. Following are considerations which must be taken into account when using such devices:

1. All lasers operated within the Commonwealth must be registered with the Pennsylvania Department of Health, Bureau of Occupational Health. This is required by law and penalties are imposed for failure to conform to this regulation.

2. Never look directly into a laser beam, even from a distance. A laser beam usually cannot be seen unless there are airborne particles such as dust or smoke to provide scattered reflective surfaces. With some lasers, the beam cannot be seen even under these conditions.

3. Do not rely upon tinted glasses, sunglasses or other eye-protective devices unless the filtering medium has been designed to attenuate the sepcific wave length produced by the laser in question. There is no single type of glass filter which will protect at all laser frequencies.

4. Never leave an activated laser unattended. An unsuspecting person may accidentially look into the beam, with resulting retinal damage. A warning sign should be posted when a laser is in operation. A bell buzzer connected into the laser circuit might be used to give an audible warning signal.

5. Keep the room lighting at a high level (about 200 foot candles) when operating the laser. This will tend to keep the eye pupil small and minimize the possibility of retinal damage due to inadvertent exposure.

6. Never shine a laser beam on any reflective surface. The reflections may approach direct beam intensities. The average science laboratory is an extremely dangerous place to operate a laser because of the presence of laboratory gas and water fixtures, which usually are chromium plated with a highly reflective surface. It is difficult if not impossible to predict the angle of reflection because of the irregular shape of the fixtures. Special care must also be taken with watch crystals, rings, metallic watch bands, tools, glassware, door knobs, screw heads and other reflective objects. The floor, bench tops and cabinets should be covered with a dark, light-diffusing material.

7. The coherent light beam is not the only possible source of danger. These devices have high voltage power supplies and physical damage may result if the high voltage terminals are contacted. All capacitors should be discharged before attempting any adjustments to the laser tube or associated electronic components.

8. The laser should not be operated in a room contaminated with smoke or dust, nor out of doors in rain, snow, fog or heavy dust. Potentially dangerous secondary specular radiation may result.

9. The flash tube of a pulsed laser should be shielded to prevent any one from looking directly at the tube when it fires. Intense light in the white, ultraviolet and infrared portions of the spectrum are produced which also may cause retinal damage.

10. A safe laser operating procedure should be established. Prepare a checklist and follow it precisely each time the laser is used.

11. Operate the laser only under direct supervision of the teacher or a qualified paraprofessional. Keep a record of the times of activation and the identities of the persons present.

12. A disarming device should be attached to the laser circuit. This device should be arranged so that the laser cannot be fired when the disarming device is removed. The teacher can remove the device or one of its components when he/she does not wish the laser to be activited.

13. Never aim the laser beam toward windows or doorways, so that persons outside the room will not be exposed inadvertently. The door or doors to the room in which the laser is operating should be locked and a warning sign should be posted to prevent any one from entering the room during the time of activation.

With the proper safety precautions such as those described above the laser can be a valuable tool for science teaching and can be operated with a minimum risk to teachers and students. If the above rules are disregarded the distinct possibility of retinal damage exists. This is a possibility which must not be tolerated.

VIII. MODEL ROCKETS

ACT 155

SESSION OF 1970

MODEL ROCKETS

ACT NO. 155 [63]

H. B. No. 1319

An Act establishing certain standards for the operation and use of model rockets and providing penalties.

The General Assembly of the Commonwealth of Pennsylvania hereby enacts as follows:

Section 1.

As used in this act, "model rocket" means an aero-model that ascends into the air without use of aerodynamic lifting forces against gravity and is propelled by means of a model rocket engine, and "model rocket engine" means a device or combination of devices which provide the necessary force or motive power to cause the model rocket to move through the air.

Section 2.

Model rockets shall comply with the following requirements prior to launch, operation and flight:

(1) Gross weight, including the model rocket engine, shall not exceed five hundred grams.

(2) No more than four ounces of propellant materials shall be contained in a model rocket engine at the moment of launch.

(3) Model rockets shall be so constructed as to be capable of repeated flights and shall contain means for retarding descent to the ground so that the structure shall not be substantially damaged and no hazard shall be created to persons and property on the ground.

(4) Construction shall be of wood, plastic, paper, rubber or similar materials and without substantial metal parts.

(5) Design and construction shall include attached surfaces which will provide aerodynamic stabilizing and restoring forces necessary to maintain a substantially true and predictable flight path.

(6) A model rocket shall not contain any type of explosive or pyrotechnic warhead.

Section 3.

Model rocket engines which supply the propulsive force for a model rocket shall conform to the following standards:

(1) A model rocket engine shall be a commercially manufactured device or combination of devices wherein all chemical ingredients of a combustible nature are pre-mixed and ready for use.

(2) The force or motive power shall be created by a rearward discharge of gas generated by the combustion or other operation of materials contained solely within such device or combinations of devices.

(3) Engines for model rockets must be certified by the National Association of Rocketry (NAR) for sales and use throughout the Commonwealth.

(4) A model rocket engine shall be so designed and constructed as to be incapable of spontaneous ignition or combustion in air, water, under pneumatic or hydraulic pressure, as a result of motion or jarring, when subjected to a temperature of 170 degrees Fahrenheit or less, or in glycerine.

63. 35 P. S. pp 1281 to 1289.

Section 4.

Model rockets may be launched, operated and flown only in a location, not otherwise restricted by law, which shall comply with the following minimum standards:

(1) There shall be a ground area whose shortest dimension is no less than one-fourth the anticipated maximum altitude of the rocket to be flown.

(2) Flight areas shall be located in such places as will not create a hazard to persons and property in the vicinity of the area.

(3) Flight areas shall not contain or be located adjacent to high voltage power lines, major highways, multi-story buildings or other obstacles.

Section 5.

Model rockets may be launched upon compliance with the following conditions:

(1) A device or mechanism shall be used which shall restrict the horizontal motion of the model until sufficient flight velocity shall have been attained for reasonably safe, predictable flight.

(2) Launching or ignition shall be conducted by remote eletrical means fully under the control of the person launching the model.

(3) A launching angle of more than sixty degrees from the horizontal shall be used.

(4) At least one adult person shall inspect each model rocket before flight and shall supervise the launching of each model rocket.

(5) All persons in the vicinity of the launching shall be advised that a launching is imminent before a model rocket may be ignited and launched.

(6) Winds shall be less than twenty miles per hour and visibility shall be greater than two thousand feet.

(7) Model rockets in flight shall not create a hazard to aircraft. Rocketeers must comply with the Federal Aviation Act of 1958 covering Federal Aviation Regulations Part 101, Subpart A pp 101.1a. 3. ii a through d.

(8) A model rocket shall not be used as a weapon against ground or air targets.

Section 6

Model rocket engines may be tested on the ground for the purpose of determining performance or may be used as the motive power of an experiment conducted on the ground under the following minimum conditions:

(1) The model rocket engine shall be affixed to a testing device or to an immovable structure in such manner that such engine may not become free during the conduct of such test or experiment.

(2) The model rocket engine shall be ignited only by remotely operated electrical means fully under the control of the person conducting the test or experiment.

(3) When tests or experiments are conducted indoors, the exhaust from each model rocket engine so tested shall be directed into a nonflammable hood or vent which shall lead directly to the outside of the building.

(4) Before a model rocket engine may be tested or used experimentally on the ground, its exhaust path shall be cleared of all inflammable objects prior to the igniting of such engine.

(5) Persons who conduct, participate in or observe static or ground testing of a model rocket engine shall stand a safe distance away from such engine, and particularly its exhaust path, at all times during the conduct of the test.

(6) At least one adult person shall inspect each model rocket engine to be tested and the testing device to be used before such test may be conducted.

(7) No model rocket engine shall be tested on the ground or shall be used as the motive power of an experiment conducted on the ground unless the conduct of such test or experiment is supervised by at least one adult person.

Section 7.

The following activities are prohibited:

(1) The use of model rocket engines for pyrotechnic purposes or for the primary purpose of producing a spectacular display of color, sound, light or any combination thereof.

(2) Tampering with or making use of a model rocket engine in any manner or degree which is contrary to the purpose for which such engine is designed and intended to be used, or contrary to the provisions of this act.

(3) The ignition of any model rocket engine with such instantaneous and violent expansion of gas or relinquishment of energy as to cause rupture of the casing.

(4) The launching, operating, discharging, flying or otherwise activating of a model rocket without first having fully complied with the foregoing provisions of this act.

Section 8.

The provisions of this act shall not apply to the design, construction, production, maintenance, launch, flight, test, operation or use of, or any other activity in connection with, a model rocket or model rocket engine, when carried on or engaged in by:

(1) The United States or this State,

(2) A college, university or other institution of higher learning, or

(3) Any individual, firm, partnership, joint venture, corporation or other business entity engaged in research, development or production of rockets, rocket engines or propellants, or components thereof, as a business.

Section 9.

Any person who violates any provision of this act shall be guilty of a misdemeanor and upon conviction there shall be fined not more than five hundred dollars ($500) or imprisoned not more than one year or both.

Approved the 8th day of July A.C. 1970.

IX. EYE SAFETY

NO. 116

HB 159 **AN ACT**

Providing for the use of eye protective devices by persons engaged in hazardous activities or exposed to known dangers in schools, colleges and universities.

The General Assembly of the Commonwealth of Pennsylvania hereby enacts as follows:

Section 1.

Every teacher, student, visitor, spectator, and every other person in any shop or laboratory in public or private schools, colleges and universities who is engaged in or is within the area of known danger created by

(1) the use of hot liquids, solids or gases, or caustic or explosive materials, or

(2) the milling, sawing, turning, shaping, cutting, grinding or stamping of solid materials, or

(3) the tempering, heat treatment or kiln firing of metals and other materials, or

(4) gas or electric welding, or

(5) the repairing or servicing of vehicles, shall wear industrial quality eye protective devices at all times while engaged in such activities or exposed to such known dangers.

Section 2.

Schools, colleges and universities shall have the power to receive Federal, State and local moneys and to expend the same to provide such devices and shall furnish such devices to all visitors and spectators and all other persons required under the provisions of this act to wear them.

Section 3.

Enforcement of this act shall be in accordance with standards, rules and regulations promulgated by the State Board of Education.

Section 4.

For the purposes of this act, "industrial quality eye protective devices" [1] mean devices meeting the standards of the American Standard Safety Code for Head, Eye and Respiratory Protection, Z2.1–1959, promulgated by the American Standards Association, Incorporated.

Section 5.

This act shall take effect immediately.

APPROVED—The 10th day of July, A. D. 1965.

WILLIAM W. SCRANTON

The foregoing is a true and correct copy of Act of the General Assembly No. 116.

Secretary of the Commonwealth.

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1 "means" in original

REGULATIONS GOVERNING THE USE AND CARE OF PROTECTIVE EYE DEVICES IN THE SCHOOLS OF PENNSYLVANIA

ENFORCEMENT OF ACT 116 of 1965

I. An Act

To provide for the use of eye protective devices by persons engaged in hazardous activities or exposed to known dangers in school colleges, and universities.

II. To Whom And Where Does It Apply

To all pupils, teachers, visitors, spectators, and every other person upon entering and/or engaging in Vocational, Industrial Arts, Science, and all other areas where known dangers exist, such as shops or laboratories in public or private schools, colleges, and universities where the activities enumerated in the Law are in progress, shall be required to wear industrial quality eye protective devices.

Known dangers are the use of hot liquids, solids or gases; caustic or explosive materials; the melting, sawing, turning, shaping, cutting, grinding or stamping of solid materials; the tempering, heat treatment or kiln firing of metals and other materials; gas or electric welding; or the repairing or servicing of vehicles. Persons exposed to these dangers shall wear industrial quality eye protective devices suitable for the specific hazards at all times while engaged in such activities or exposed to such known dangers.

Enforcement of this Act shall include custodial, service, food preparation, and other areas of school operation where eye hazards exist.

For the purpose of implementing this act, "industrial quality eye protective devices" means devices meeting the standards of the American Standard Safety Code for Head, Eye, and Respiratory Protection, Z2.1 – 1959, promulgated by the American Standards Association, Incorporated.

III. Who Is Responsible

Local boards of school directors, boards of education, college boards of trustees, and governing bodies of private schools shall adopt such rules and regulations as may be necessary for the provision, maintenance, and use of eye protective devices as required to meet the provisions of the law.

IV. For Non-Compliance

In cases of non-compliance the Superintendent of Public Instruction may take whatever action is deemed necessary.

X. SAFETY CONSIDERATIONS IN THE USE OF EQUIPMENT PRODUCING IONIZING RADIATION

High-voltage equipment may produce various kinds of radiation, but only ionizing types of radiation such as x-rays and electrons are considered here. X-rays are produced where electrons or other charged particles bombard matter. This requires:

1. An electron source as cathode;

2. A target or anode which the electrons can strike;

3. A high potential difference between the anode and cathode, such that the electrons will attain sufficiently high velocity either to radiate significantly on rapid deceleration (Bremsstrahlung) or to displace inner-shell electrons in the target material, resulting in emission of characteristic x-rays.

4. Low gas pressure between cathode and anode, i.e., a moderately good gas vacum.

A wide variety of high-voltage gaseous discharge and electronic tubes satisfy these basic requirements and hence produce x-rays. The quantity and energy of the radiation produced will depend on the construction of the tube and its operating current and voltage. *Wherever there is a choice, the tube should be operated at its lowest current and its lowest voltage.*

A. X-ray Devices

This category includes therapeutic, radiographic, fluoroscopic and dental x-ray machines, x-ray diffraction apparatus, industrial x-ray generators and shoefitting fluoroscopes. None of these devices shall be used unless operated by a person familiar with x-ray safety precautions and with the operation of the specific machine. *Never expose any part of the human body to the Radiation Beam. Do not use x-rays on humans for demonstration purposes. Fluoroscopes are particularly hazardous and shall not be used.*[1]

Any electronic tube operating at a potential above 10 KeV should be considered as a possible source of x-radiation even though it was not designed for that purpose. These include:

1. Electron microscopes and their power supplies.

2. High power amplifying tubes, such as klystrons and magnetrons used for production of microwave fields.

3. Radio transmitting tubes.

4. High voltage rectifier tubes, such as those used in power supplies.

5. Discharge tubes in which the gas pressure may be varied while studying electrical discharges.

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1. National Council on Radiation Protection, Radiation Protection in Educational Institutions, 1973. 7109 Woodmont Avenue, Washington, DC 20014.

These devices are not considered dangerous when operating at voltages below 10 KeV since the tube walls will attenuate the radiation.

Several types of equipment normally found in schools may be perfectly safe to use by themselves but not when used in conjunction with another item. For example the induction coil, Tesla coils, Wimhurst static machines and small Van de Graaff generators are normally operated at atmospheric pressure, and do not produce x-rays. However, if the voltage from such a source is applied across an evacuated discharge tube, the production of x-rays can become a significant hazard.

GENERAL RULES FOR THE USE OF THE EQUIPMENT PRODUCING IONIZING RADIATION

1. Operate all high voltage tubes at their lowest possible current and voltage.

2. Never expose any part of the human body to an x-ray beam. Do not use x-rays on humans for demonstration purposes.

3. Never use a fluoroscopic device.

4. Shield all electronic tubes which operate above 10 KeV to attenuate the x-rays produced.

5. Do not use induction coils, Tesla coils, Wimhurst machines or Van de Graaff generators in conjunction with any discharge tube.

XI. SAFETY PRECAUTIONS IN THE USE OF RADIOISOTOPES

Sealed or unsealed sources of radioactive materials produce a specific type of hazard requiring special precautions. Properly used they present less hazard than the corrosive acids routinely used in the laboratory. To insure safety in the laboratory while using radioactive materials, the following rules should be adopted and rigidly enforced by the instructor. Students should be given a copy of these rules, and should be thoroughly familiar with them before being allowed to work in the radioisotope laboratory. Any person who breaks these rules should be seriously reprimanded. A copy should be posted in a prominent place within the laboratory.

ALL PRECAUTIONS POSSIBLE MUST BE TAKEN TO PREVENT INHALATION, INGESTION OR SKIN CONTACT WITH RADIOISOTOPES, AND TO MINIMIZE EXPOSURE TO IONIZING RADIATION. THEREFORE, THE FOLLOWING RULES WILL BE IN EFFECT:

1. There will be no eating, drinking or smoking in this laboratory.

2. Keep your hands away from your mouth, nostrils and eyes.

3. All work with unsealed sources must be carried out in fiberglass worktrays. These trays will be lined with paper having a non-absorbent base to retain spills and facilitate decontamination.

4. Laboratory coats must be worn at all times when working in this laboratory.

5. Rubber or plastic gloves will be worn at all times when handling unsealed solutions. These gloves must be washed with detergent and water, monitored, and rewashed if contaminated, before removal. The hands will then be washed and monitored.

6. Signs indicating radioactive materials and bearing the radiation symbol must be in prominent display during any experiment with unsealed radioactive sources.

7. All radioactive contaminated materials must be plainly labeled.

8. Solid radioactive waste will be placed in the clearly marked "hot" waste can. No other type of waste will be placed in this can, and no solid radioactive materials will be disposed of elsewhere.

9. The instructor will be consulted before any liquid radiosotopes may be disposed of, to insure proper disposal.

10. There must be no pipetting by mouth. A propipetter will be used.

11. All spills of radioactive material must be reported to the instructor immediately, and decontamination procedures initiated under his/her personal supervision.

12. All radioactive sources should be dried and sealed before counting to avoid contaminating the equipment.

If you should have any questions concerning the proper use or disposal of radioactive material, please contact one of the following:

John J. McDermott
Senior Program Adviser, Science
Bureau of Curriculum Services
Pennsylvania Department of Education
P. O. Box 911, 333 Market Street
Harrisburg, PA 17108
(717) 787-7320

Thomas M. Gerusky, Director
Bureau of Radiation Protection and Toxicology
Pennsylvania Department of Environmental Resources
Fifth Floor, Fulton Building
Harrisburg, PA 17126
(717) 787-2480

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Chemical Rubber Co. **Handbook of Laboratory Safety** Cleveland, Ohio Second Edition, 1971.

Irving, James R. **How To Provide for Safety in the Science Laboratory**, National Science Teachers Association, Washington, D.C. 1968

Manufacturing Chemists Association **Laboratory Waste Disposal Manual** Washington, D.C. 1973

National Science Teachers Association **Safety in the Secondary Science Classroom** Washington, D.C. 1978

U. S. Department of Education **Safety in the School Sciences Laboratory: Instructor's Resource Guide** Washington, D.C. August, 1977

APPENDIX

Items Pertaining to Laboratory Safety Considerations

Commonwealth of Pennsylvania
Department of Education

BASIC EDUCATION CIRCULAR 12—76

DATE ISSUED	January 30, 1976
NUMBER OF SHEETS	1
DATE EXPIRES	Indefinite

THIS MATERIAL MAY BE REPRODUCED

Subject: Possible Carcinogens in the High School Science Laboratory

To: Chief School Administrators
Intermediate Unit Executive Directors
School Board Secretaries
Area Vocational Technical Schools

From: Frank S. Manchester
Commissioner for Basic Education

Administrators: Please distribute this memo to your science teachers.

Several chemicals which have been found to cause cancers in animals and/or humans may be in use in high school or college laboratories within the Commonwealth. Because some of these compounds have a long latency period, they may produce carcinomas several years after exposure.

For this reason we recommend that students be prohibited from conducting experiments using the following polycyclic or polynuclear organic compounds:

4-Nitrobiphenyl
alpha-Naphthylamine
beta-Naphthylamine
Methyl chloromethyl ether
3, 3' Dichlorobenzidine
Benzidine
4-Aminodiphenyl
Ethyleneimine
beta-Propiolactone
2-Acetylaminoflorene
4-Dimethylaminoazobenzene
N-Nitrosodimethylamine
Vinyl Chloride
bis (Chloromethyl)

Although exposure to these chemicals under normal classroom circumstances would be minimal compared with the daily exposure in industry which might cause cancer, the fact that these chemicals are proven carcinogens justifies prohibiting their use in the secondary school laboratory.

If you have any questions about the use or disposal of these chemicals, please contact:

John J. McDermott
Senior Program Adviser, Science
Pennsylvania Department of Education
Box 911
Harrisburg, PA 17126
(717) 787-7320

John W. Knauber, Director
Bureau of Occupational Health
Pennsylvania Department of
Environmental Resources
Sixth Floor Fulton Building
Harrisburg, PA 17126
(717) 787-6525

Commonwealth of Pennsylvania
DEPARTMENT OF EDUCATION

November 5, 1976

SUBJECT: Alternative Naming of Carcinogens in Possible Use in Pennsylvania Schools

TO: Chief School Administrators
Intermediate Unit Executive Directors
Area Vocational-Technical Schools
Diocesan Superintendents
Administrators of Nonpublic Schools

Note: Please distribute this announcement to your science teachers.

FROM: Bertha P. Boyd Bertha P. Boyd
Assistant Commissioner for Basic Education

Basic Education Circular 12-76, issued January 30, 1976, listed chemicals in possible use in high school or college laboratories which have been found to cause cancers in animals and/or humans. It was strongly recommended that their use be prohibited in secondary school laboratories.

Because various systems of nomenclature are used in chemistry today, many of these cancer- causing chemicals have more than one name. A list of alternate names for these compounds follows:

Carcinogens and Synonyms

Carcinogen	Synonyms
Benzidine	Benzidin 4,4'-Biphenyldiamine C.I. Azoic Diazo Component 112 4,4' -Diaminobiphenyl p-Diaminodiphenyl 4,4' -Diaminodiphenyl 4,4; -Diphenylenediamine Fast Corinth Base B
Bischloromethyl Ether	Bis-CME BCME Chloromethyl Ether sym-Dichloromethyl Ether
Beta-Propiolactone	2-Oxetanone Betaprone BPL Hydracrylic Acid, beta, Lactone 3-Hydroxypropionic Acid Lactone Propanolide Beta-Propionolactone Beta-Proprolactone

Dichlorobenzidine	3,3'-Dichlorobenzidine 4,4'-Diamino-3,3'-Dichlorobiphenyl 3,3'-Dichlorbenzidin O,O'-Dichlorobenzidine 3,3'-Dichloro-4,4'-Biphenyldiamine 3,3'-Dichlorobiphenyl-4,4'-Diamine 3,3'-Dichloro-4,4'-Diaminobiphenyl
Alpha-Naphthylamine	1-Naphthylamine 1-Aminonaftalen 1-Aminonaphathalene Antioxidant-MB C.I. Azoic Diazo Component 114 Fast Garnet B Base Fast Garnet Base B Alpha-Nafthylamin Naphthalidam Naphthalidine
Beta-Naphthylamine	2-Naphthylamine 2-Aminonaftalen C.I. 37270 Fast Scarlet Base B 2-Naphthalenamine Beta-Nafthylamin
Acetyl-Aminofluorene	AAF 2-AAF 2-Acetamidofluorene 2-Acetaminofluorene N-Acetyl-2-Aminofluorene 2-Acetylaminofluorene FAA 2-FFA N-2-Fluorenylacetamide N-Fluoren-2-ylacetamide
Aminodiphenyl	4-Biphenylamine p-Aminobiphenyl 4-Aminobiphenyl p-Aminodiphenyl 4-Aminodiphenyl Biphenylamine 1,1'-Biphenyl-4-Amine p-Biphenylamine p-Phenylaniline Xenylamin Xenylamine

Dimethyl-Aminoazobenzene	p-Dimethylaminoazobenzene
	Benzeneazodimethylaniline
	Brilliant Fast Oil Yellow
	Brilliant Fast Spirit Yellow
	Brilliant Oil Yellow
	Butter Yellow
	Cerasine Yellow GG
	C.I. 11020
	C.I. Solvent Yellow 2
	DAB
	N,N-Dimethy-4-Aminoazobenzene
	p-Bimethylaminoazobenzen
	p-Dimethylaminoazobenzene
	4-Dimethylaminoazobenzene
	4-(N,N-Dimenthylamino)azobenzene
	4-Dimethylaminoazobenzol
	4-Dimethylaminophenylazobenzene
	N,N-Dimethyl-p-Phenylazoaniline
	Dimethyl Yellow
	DMAB
	Enial Yellow 2G
	Fast Oil Yellow B
	Fat Yellow
	Fat Yellow A
	Fat Yellow R
	Fat Yellow Ad OO
	Fat Yellow ES
	Fat Yellow ES Extra
	Fat Yellow extra conc
Dimethyl-Aminoazobenzene	Grasal Brillian Yellow
	Methyl Yellow
	Oil Yellow D
	Oil Yellow G
	Oil Yellow 2G
	Oil Yellow 20
	Oil Yellow 2625
	Oil Yellow BB
	Oil Yellow FN
	Oil Yellow GG
	Oil Yellow GR
	Oil Yellow II
	Oil Yellow Pel
	Oleal Yellow 2G
	Orangol Yellow ADM
	Orient Oil Yellow GG
	Petrol Yellow WT
	Resinol Yellow GR
	Silotras Yellow T2G
	Somalia Yellow A

	Stear Yellow JB
	Sudan Yellow GG
	Sudan Yellow GGA
	Toyo Oil Yellow G
	Waxoline Yellow ADS
	Yellow G Soluble in Grease
	Zlut Maselna
Nitrobiphenyl	p-Nitrobiphenyl
	4-Nitrobiphenyl
	4-Nitrodiphenyl
Nitro-Sodimethylamine	N-Nitrosodimethylamine
	N,N-Dimethylnitrosamine
	Dimethylnitrosoamine
	DMN
	DMNA
Methyl Chloromethyl Ether	Chlordimethylether
	Chloromethyl Methyl Ether
	CMME
Methylene (BIS)-Chloroaniline	4,4'-Methylenebiso 2-chlorobenzenamine
	Aniline, 4,4'-Methylenebiso-2-Chloro
	3,3'-Dichloro-4,4'-Diaminodipheylmethane
	4,4'-Methylene(Bis)-Chloroaniline
	Methylene 4,4'-Bis(o-Chloroaniline)
	p,p'-Methylenebis (alpha-Chloroaniline)
	4,4'-Methylenebis (2-Chloroaniline)
	4,4'-Methylenebis (o-Chloroaniline)
	MOCA
Ethyleneimine	Azocyclopropane
	Aziridine
	IH-Azirine, Dihydro
	Dimethylenimine
	El
	Ethylenimine
	Ethylimine
Vinyl Chloride	Chloroethene
	Chloroethylene
	Trovidur
	Vinyl C. Monomer

If you have any questions about the use or disposal of these chemicals, please contact:

John J. McDermott
Senior Program Adviser, Science
Pennsylvania Department of Education
P.O. Box 911
Harrisburg, PA 17126
Telephone: 717/787/7320

II SOURCES OF RADIOISOTOPES, LICENSING

On June 14, 1946, an article appeared in Science announcing that reactor radioisotopes were available from government agencies. On August 2, 1946 the initial shipment, a small amount of Carbon-14, was sent to the Barnard Cancer Hospital in St. Louis, Missouri.

By 1959, the Atomic Energy Commission (presently the U.S. Energy Research and Development Administration) had issued licenses to 2,555 institutions for use in medical application, 16,000 to individual companies, and 1,562 to research groups.

> "Figures from Oak Ridge National Laboratory show a rise from 14,162 shipments of a total of 166,629 curies[7] in 1957, to 14,131 shipments of 228,714 curies in the next year, and 12,028 shipments of a total of 222,708 curies in the current year ended November 30, 1959. The shipments do not include those of retail suppliers which approximate 1,000,000 shipments per year."[8]

On January 11, 1956, the Commission made available to the general public small amounts of radioactive materials. Following are excerpts from: *Rules of General Applicability to Licensing of Byproduct Material*, U.S. Nuclear Regulatory Commission Rules and Regulations, Title 10, Chapter 1, Part 30, April 30, 1975.

> **30.18 Exempt quantities.**
>
> (a) Except as provided in paragraphs (c) and (d) of this section, any person is exempt from the requirements for a license set forth in section 81 of the Act and from the regulations in Parts 30-34 of this chapter to the extent that such person receives, possesses, uses, transfers, owns, or acquires byproduct material in individual quantities each of which does not exceed the applicable quantity set forth in S30.71, Schedule B.
>
> (b) Any person who possesses byproduct material received or acquired prior to September 25, 1971, under the general license then provided in S 31.4 of this chapter is exempt from the requirements for a license set forth in section 81 of the Act and from the regulations in Parts 30.34 of this chapter to the extent that such person possesses, uses, transfers, or owns such byproduct material.
>
> (c) This section does not authorize the production, packaging, repackaging, or import of byproduct material for purposes of commercial distribution...
>
> (d) (Refers to restrictions on commercial distribution, import, or transfer of byproduct materials.)
>
> **30.21 General licenses.**
>
> (a) A general license is hereby issued: (2) to transfer, receive, acquire, own, possess, use, and import the quantities of byproduct material listed in 30.71, provided that no person shall at any one time possess or use, pursuant to the general licensing provisions of this paragraph, more than a total of ten such scheduled quantities.

[7] A curie is the number of radioactive disintegrations equal to that undergone by one gram of radium; i.e. 3.7×10^{10} disintegrations sec. $^{-1}$

[8] Radioisotopes in Science and Industry, A Special Report of the Atomic Energy Commission. January, 1960, p. 2.

30.31 Types of licenses.

Licenses for byproduct material are of two types: General and specific. Specific licenses are issued to named persons upon applications filed pursuant to the regulations in this part of Part 32.36. General licenses are effective without the filing of applications with the Commission or the issuance of licensing documents to particular persons.

30.32 Application for specific licenses.

(a) Applications for specific licenses should be filed in duplicate on Form NRC-313. *"Application for Byproduct Material License."* with the Director of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

30.71 Schedule B.

The following quantities of byproduct material are generally licensed pursuant to 30.21 (a) (2).

Byproduct Material	*Microcuries*	*Byproduct Material*	*Microcuries*
Antimony 122 (Sb 122)	400	Cobalt 58 (Co 58)	10
Antimony 124 (Sb 124)	10	Cobalt 60 (Co 60)	1
Antimony 125 (Sb 125)	10	Copper 64 (Cu 64)	100
Arsenic 73 (As 73)	100	Dysprosium 165 (Dy 165)	10
Arsenic 74 (As 74)	10	Dysprosium 166 (Dy 166)	100
Arsenic 76 (As 76)	10	Erbium 169 (Er 169)	100
Arsenic 77 (As 77)	100	Erbium 171 (Er 171)	100
Barium 131 (Ba 131)	10	Europium 151 9.2h (Eu 152 9.2h)	100
**Barium-133 (Ba 133)	10	Europium 152 13 yr (Eu 152 13 yr)	1
Barium (140 (Ba 140)	10	Europium 154 (Eu 154)	1
Bismuth 210 (Bi 210)	1	Europium 155 (Eu 155)	10
Bromine 82 (Br 82)	10	Fluorine 18 (F 18)	1,000
Cadmium 109 (Cd 109)	10	Gadolinium 153 (Gd 153)	10
Cadmium 115m (Cd 115m)	10	Gadolinium 159 (Gd 159)	100
Cadmium 115 (Cd 115)	100	Gallium 72 (Ga 72)	10
Calcium 45 (Ca 45)	10	Germanium 71 (Ge 71)	100
Calcium 47 (Ca 47)	10	Gold 198 (Au 198)	100
Carbon 14 (C 14)	100	Gold 199 (Au 199)	100
Cerium 141 (Ce 141)	100	Hafnium 181 (Hf 181)	10
Cerium 143 (Ce 143)	100	Holmium 166 (Ho 166)	100
Cerium 144 (Ce 144)	1	Hydrogen 3 (H 3)	1,000
Cesium 131 (Cs 131)	1,000	Indium 113m (In 113m)	100
Cesium 134m (Cs 134m)	100	Indium 114m (In 114m)	10
Cesium 134 (Cs 134)	1	Indium 115m (In 115m)	100
Cesium 135 (Cs 135)	10	Indium 115 (In 115)	10
Cesium 136 (Cs 136)	10	Iodine 125 (I 125)	1
Cesium 137 (Cs 137)	10	Iodine 126 (I 126)	1
Chlorine 36 (Cl 36)	10	Iodine 129 (I 129)	0.1
Chlorine 38 (Cl 38)	10	Iodine 131 (I 131)	1
Chromium 51 (Cr 51)	1,000	Iodine 132 (I 132)	10
Cobalt 58m (Co 58m)	10	Iodine 133 (I 133)	1

Byproduct Material	*Microcuries*
Iodine 134 (I 134)	*10*
Iodine 135 (I 135)	*10*
Iridium 192 (Ir 192)	*10*
Iridium 194 (Ir 194)	*100*
Iron 55 (Fe 55)	*100*
Iron 59 (Fe 59)	*10*
Krypton 85 (Kr 85)	*100*
Krypton 87 (Kr 87)	*10*
Lanthanum 140 (La 140)	*10*
Lutetium 177 (Lu 177)	*100*
Manganese 52 (Mn 52)	*10*
Manganese 54 (Mn 54)	*10*
Manganese 56 (Mn 56)	*10*
Mercury 197m (Hg 197m)	*100*
Mercury 197 (Hg 197)	*100*
Mercury 203 (Hg 203)	*10*
Molybdenum 99 (Mo 99)	*100*
Neodymium 147 (Nd 147)	*100*
Neodymium 149 (Nd 149)	*100*
Nickel 59 (Ni 59)	*100*
Nickel 63 (Ni 63)	*10*
Nickel 65 (Ni 65)	*100*
Niobium 93m (Nb 93m)	*10*
Niobium 95 (Nb 95)	*10*
Niobium 97 (Nb 97)	*10*
Osmium 185 (Os 185)	*10*
Osmium 191m (Os 191m)	*100*
Osmium 191 (Os 191)	*100*
Osmium 193 (Os 193)	*100*
Palladium 103 (Pd 103)	*100*
Palladium 109 (Pd 109)	*100*
Phosphorus 32 (P 32)	*10*
Platinum 191 (Pt 191)	*100*
Platinum 193m (Pt 193m)	*100*
Platinum 193 (Pt 193)	*100*
Platinum 197m (Pt 197m)	*100*
Platinum 197 (Pt 197)	*100*
Polonium 210 (Po 210)	*0.1*
Potassium 42 (K 42)	*10*
Praseodymium 142 (Pr 142)	*100*
Praseodymium 143 (Pr 143)	*100*
Promethium 147 (Pm 147)	*10*
Promethium 149 (Pm 149)	*10*
Rhenium 186 (Re 186)	*100*
Rhenium 188 (Re 188)	*100*
Rhodium 103m (Rh 103m)	*100*
Rhodium 105 (Rh 105)	*100*
Rubidium 86 (Rb 86)	*10*
Rubidium 87 (Rb 87)	*10*
Ruthenium 97 (Ru 97)	*100*
Ruthenium 103 (Ru 103)	*10*
Ruthenium 105 (Ru 105)	*10*
Ruthenium 106 (Ru 106)	*1*

Byproduct Material	*Microcuries*
Samarium 151 (Sm 151)	10
Samarium 153 (Sm 153)	100
Scandium 46 (Sc 46)	10
Scandium 47 (Sc 47)	100
Scandium 48 (Sc 48)	10
Selenium 75 (Se 75)	10
Silicon 32 (Si 31)	100
Silver 105 (Ag 105)	10
Silver 110m (Ag 110m)	1
Silver 111 (Ag 111)	100
Sodium 24 (No 24)	10
Strontium 85 (Sr 85)	10
Strontium 89 (Sr 89)	1
Strontium 90 (Sr 90)	0.1
Strontium 91 (Sr 91)	10
Strontium 92 (Sr 92)	10
Sulphur 35 (S 35)	100
Tantalum 182 (Ta 182)	10
Technetium 96 (Tc 96)	10
Technetium 97m (Tc 97m)	100
Technetium 97 (Tc 97)	100
Technetium 99m (Tc 99m)	100
Technetium 99 (Tc 99)	10
Tellurium 125m (Tc 125m)	10
Tellurium 127m (Te 127m)	10
Tellurium 127 (Te 127)	100
Tellurium 129m (Te 129m)	10
Tellurium 129 (Te 129)	100
Tellurium 131m (Te 131m)	10
Tellurium 132 (Te 132)	10
Terbium 160 (Tb 160)	10
Thallium 200 (Tl 200)	100
Thallium 201 (Tl 201)	100
Thallium 202 (Tl 202)	100
Thallium 204 (Tl 204)	10
Thulium 170 (Tm 170)	10
Thulium 171 (Tm 171)	10
Tin 113 (Sn 113)	10
Tin 125 (Sn 125)	10
Tungsten 181 (W 181)	10
Tungsten 185 (W 185)	10
Tungsten 187 (W 187)	100
Vanadium 48 (V 48)	10
Xenon 131m (Xe 131m)	1,000
Xenon 133 (Xe 133)	100
Xenon 135 (Xe 135)	100
Ytterbium 175 (Yb 175)	100
Yttrium 90 (Y 90)	10
Yttrium 91 (Y 91)	10
Yttrium 92 (Y 92)	100
Yttrium 93 (Y 93)	100
Zinc 65 (Zn 65)	10
Zinc 69m (Zn 69m)	100

Byproduct Material	*Microcuries*
Zinc 69 (Zn 69)	1,000
Zirconium 93 (Zr 93)	10
Zirconium 95 (Zr 95)	10
Zirconium 97 (Zr 97)	10
Any byproduct material not listed above other than alpha emitting byproduct material	

Isotope	Usual Chemical Form	Half-Life	Beta Energy (MeV)	Gamma Energy (MeV)
Iodine 131	NaI	8.08 days	0.608 et.	0.364 et.
Phosphorus 32	NaH_2PO_4	14.3 days	1,701	None
Calcium 45	$CaCl_2$	163 days	0.254	None
Carbon 14	Na_2CO_3	5,562 yrs	0.155	None
Cesium 137	CsCl	30 yrs	0.51 et	None
Barium 137	$BaCl_2$	2.6 min.	None	0.662
Chlorine 36	KCl	308,000 yrs	0.714	None
Chromium 51	$CrCl_3$	27.8 days	None	0.32 et
Cobalt 60	$CoCl_2$	5.27 yrs	0.306	1.17, 1.33
Indium 113m	$InCl_3$	100 min.	None	.393
Iron 59	$FeCl_3$	45.1 days	0.462 et	0.191, 1098 1.289
Nickel 63	$NiCl_2$	85 yrs	0.067	None
Ruthenium 106	$RuCl_3$	1.0 yrs	0.0392	None
Rhodium 106	$RhCl_3$	30 sec.	3.53 et	0.513, 2.41 et
Sodium 22	NaCl	2.6 yrs	0.58 β^+	0.511, 1.28
Strontium 89	$SrCl_2$	53 days	1.463	None
Strontium 90	$SrCl_2$	25 yrs	0.61	None
Sulfur 35	H_2SO_4	87.1 days	0.167	None
Thallium 204	$TlNO_3$	4.0 yrs	0.765	None
Yttrium 90	YCl_3	2.54 days	2.18	None
Zinc 65	$ZnCl_2$	250 days	0.325 β^+	1.12 et

PART 19

NOTICES, INSTRUCTIONS, AND REPORTS TO WORKERS; INSPECTIONS

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19.4 Interpretations.
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19.11 Posting of notices to workers.
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19.16 Requests by workers for inspections.
19.17 Inspection not warranted; informal review.
19.20 Violations.
19.31 Application for exemptions.
19.32 Discrimination prohibited.

AUTHORITY: Secs. 53, 63, 81, 103, 104, 161, Pub. L. 83-703, 68 Stat. 930, 938, 935, 936, 937, 948, as amended (42 U.S.C. 2073, 2093, 2111, 2133, 2134, 2201); Sec. 401, Pub. L. 93-438, 88 stat. 1254 (42 U.S.C. 5891)

§ 19.1 Purpose.

The regulations in this part establish requirements for notices, instructions, and reports by licensees to individuals participating in licensed activities, and options available to such individuals in connection with Commission inspections of licensees to ascertain compliance with the provisions of the Atomic Energy Act of 1954, as amended, Title II of the Energy Reorganization Act of 1974, and regulations, orders, and licenses thereunder regarding radiological working conditions.

[40 FR 8774]

§ 19.2 Scope.

The regulations in this part apply to all persons who receive, possess, use, or transfer material licensed by the Nuclear Regulatory Commission pursuant to the regulations in Parts 30 through 35, 40, or 70 of this chapter, including persons licensed to operate a production or utilization facility pursuant to Part 50 of this chapter.

[38 FR 22217]

§ 19.3 Definitions.

As used in this part:

(a) "Act" means the Atomic Energy Act of 1954, (68 Stat. 919) including any amendments thereto;

(b) "Commission" means the United States Nuclear Regulatory Commission;

(c) "Worker" means an individual engaged in activities licensed by the Commission and controlled by a licensee, but does not include the licensee.

(d) "License" means a license issued under the regulations in Parts 30 through 35, 40, or 70 of this chapter, including licenses to operate a production or utilization facility pursuant to Part 50 of this chapter. "Licensee" means the holder of such a license.

(e) "Restricted area" means any area access to which is controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials. "Restricted area" shall not include any areas used as residential quarters, although a separate room or rooms in a residential building may be set apart as a restricted area.

[38 FR 22217]

§ 19.4 Interpretations.

Except as specifically authorized by the Commission in writing, no interpretation of the meaning of the regulations in this part by any officer or employee of the Commission other than a written interpretation by the General Counsel will be recognized to be binding upon the Commission.

§ 19.5 Communications.

Except where otherwise specified in this part, all communications and reports concerning the regulations in this part should be addressed to the Director, Office of Inspection and Enforcement, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555. Communications, reports, and applications may be delivered in person at the Commission's offices at 1717 H Street, NW., Washington, D.C.; or at 7920 Norfolk Avenue, Bethesda, Maryland.

[40 FR 8774]

§ 19.11 Posting of notices to workers.

(a) Each licensee shall post current copies of the following documents: (1) The regulations in this part and in Part 20 of this chapter; (2) the license, license conditions, or documents incorporated into a license by reference, and amendments thereto; (3) the operating procedures applicable to licensed activities; (4) any notice of violation involving radiological working conditions, proposed imposition of civil penalty, or order issued pursuant to Subpart B of Part 2 of this chapter, and any response from the licensee.

[38 FR 22217]

(b) If posting of a document specified in paragraph (a) (1), (2) or (3) of this section is not practicable, the licensee may post a notice which describes the document and states where it may be examined.

(c) Form NRC-3, "Notice to Employees", shall be posted by each licensee wherever individuals work in or frequent any portion of a restricted area.

[40 FR 8774]

NOTE: Copies of Form NRC-3 may be obtained by writing to the Director of the appropriate U.S. Nuclear Regulatory Commission Inspection and Enforcement Regional Office listed in Appendix "D", Part 20 of this chapter, or the Director, Office of Inspection and Enforcement, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

(d) Documents, notices, or forms posted pursuant to this section shall appear in a sufficient number of places to permit individuals engaged in licensed activities to observe them on the way to or from any particular licensed activity location to which the document applies, shall be conspicuous, and shall be replaced if defaced or altered.

(e) Commission documents posted pursuant to paragraph (a)(4) of this section shall be posted within 2 working days after receipt of the documents from the Commission; the licensee's response, if any, shall be posted within 2 working days after dispatch by the licensee. Such documents shall remain posted for a minimum of 5 working days or until action correcting the violation has been completed, whichever is later.

[38 FR 22217]

§ 19.12 Instructions to workers.

All individuals working in or frequenting any portion of a restricted area shall be kept informed of the storage, transfer, or use of radioactive materials or of radiation in such portions of the restricted area; shall be instructed in the health protection problems associated with exposure to such radioactive materials or radiation, in precautions or procedures to minimize exposure, and in the purposes and functions of protective devices employed; shall be instructed in, and instructed to observe, to the extent within the worker's control, the applicable provisions of Commission regulations

and licenses for the protection of personnel from exposures to radiation or radioactive materials occurring in such areas; shall be instructed of their responsibility to report promptly to the licensee any condition which may lead to or cause a violation of Commission regulations and licenses or unnecessary exposure to radiation or to radioactive material; shall be instructed in the appropriate response to warnings made in the event of any unusual occurrence or malfunction that may involve exposure to radiation or radioactive material; and shall be advised as to the radiation exposure reports which workers may request pursuant to § 19.13. The extent of these instructions shall be commensurate with potential radiological health protection problems in the restricted area.

§ 19.13 Notifications and reports to individuals.

(a) Radiation exposure data for an individual, and the results of any measurements, analyses, and calculations of radioactive material deposited or retained in the body of an individual, shall be reported to the individual as specified in this section. The information reported shall include data and results obtained pursuant to Commission regulations, orders or license conditions, as shown in records maintained by the licensee pursuant to Commission regulations. Each notification and report shall: be in writing; include appropriate identifying data such as the name of the licensee, the name of the individual, the individual's social security number; include the individual's exposure information; and contain the following statement:

38 FR 22217

This report is furnished to you under the provisions of the Nuclear Regulatory Commission regulation 10 CFR Part 19. You should preserve this report for further reference.

(b) At the request of any worker, each licensee shall advise such worker annually of the worker's exposure to radiation or radioactive material as shown in records maintained by the licensee pursuant to § 20.401(a) and (c).

(c) At the request of a worker formerly engaged in licensed activities controlled by the licensee, each licensee shall furnish to the worker a report of the worker's exposure to radiation or radioactive material. Such report shall be furnished within 30 days from the time the request is made, or within 30 days after the exposure of the individual has been determined by the licensee, whichever is later; shall cover, within the period of time specified in the request, each calendar quarter in which the worker's activities involved exposure to radiation from radioactive materials licensed by the Commission; and shall include the dates and locations of licensed activities in which the worker participated during this period.

(d) When a licensee is required pursuant to § 20.405 or § 20.408 of this chapter to report to the Commission any exposure of an individual to radiation or radioactive material the licensee shall also provide the individual a report on exposure data included therein. Such report shall be transmitted at a time not later than the transmittal to the Commission.

§ 19.14 Presence of representatives of licensees and workers during inspections.

(a) Each licensee shall afford to the Commission at all reasonable times opportunity to inspect materials, activities, facilities, premises, and records pursuant to the regulations in this chapter.

(b) During an inspection, Commission inspectors may consult privately with workers as specified in § 19.15. The licensee or licensee's representative may accompany Commission inspectors during other phases of an inspection.

(c) If, at the time of inspection, an individual has been authorized by the workers to represent them during Commission inspections, the licensee shall notify the inspectors of such authorization and shall give the workers' representative an opportunity to accompany the inspectors during the inspection of physical working conditions.

(d) Each workers' representative shall be routinely engaged in licensed activities under control of the licensee and shall have received instructions as specified in § 19.12.

(e) Different representatives of licensees and workers may accompany the inspectors during different phases of an inspection if there is no resulting interference with the conduct of the inspection. However, only one workers' representative at a time may accompany the inspectors.

(f) With the approval of the licensee and the workers' representative an individual who is not routinely engaged in licensed activities under control of the license, for example, a consultant to the licensee or to the workers' representative, shall be afforded the opportunity to accompany Commission inspectors during the inspection of physical working conditions.

(g) Notwithstanding the other provisions of this section, Commission inspectors are authorized to refuse to permit accompaniment by any individual who deliberately interferes with a fair and orderly inspection. With regard to areas containing information classified by an agency of the U.S. Government in the interest of national security, an individual who accompanies an inspector may have access to such information only if authorized to do so. With regard to any area containing proprietary information, the workers' representative for that area shall be an individual previously authorized by the licensee to enter that area.

§ 19.15 Consultation with workers during inspections.

(a) Commission inspectors may consult privately with workers concerning matters of occupational radiation protection and other matters related to applicable provisions of Commission regulations and licenses to the extent the inspectors deem necessary for the conduct of an effective and thorough inspection.

(b) During the course of an inspection any worker may bring privately to the attention of the inspectors, either orally or in writing, any past or present condition which he has reason to believe may have contributed to or caused any violation of the act, the regulations in this chapter, or license condition, or any unnecessary exposure of an individual to radiation from licensed radioactive material under the licensee's control. Any such notice in writing shall comply with the requirements of § 19.16(a).

(c) The provisions of paragraph (b) of this section shall not be interpreted as authorization to disregard instructions pursuant to § 19.12.

§ 19.16 Requests by workers for inspections.

(a) Any worker or representative of workers who believes that a violation of the Act, the regulations in this chapter, or license conditions exists or has occurred in license activities with regard to radiological working conditions in which the worker is engaged, may request an inspection by giving notice of the alleged violation to the Director of Inspection and Enforcement, to the Director of the appropriate Commission Regional Office, or to Commission inspectors. Any such notice shall be in writing, shall set forth the specific grounds for the notice, and shall be signed by the worker or representative of workers. A copy shall be provided the licensee by the Director of Inspection and Enforcement, Regional Office Director, or the inspector no later than at the time of inspection except that, upon the request of the worker giving such notice, his name and the name of individuals referred to therein shall not appear in such copy or on any record published, released, or made available by the Commission, except for good cause shown.

38 FR 22217

(b) If, upon receipt of such notice, the Director of Inspection and Enforcement or Regional Office Director determines that the complaint meets the requirements set forth in paragraph (a) of this section, and that there are reasonable grounds to believe that the alleged violation exists or has occurred, he shall cause an inspection to be made as soon as practicable, to determine if such alleged violation exists or has occurred. Inspections pursuant to this section need not be limited to matters referred to in the complaint.

(c) No licensee shall discharge or in any manner discriminate against any worker because such worker has filed any complaint or instituted or caused to be instituted any proceeding under the regulations in this chapter or has testified or is about to testify in any such proceeding or because of the exercise by such worker on behalf of himself or others of any option afforded by this part.

§ 19.17 Inspections not warranted; informal review.

(a) If the Director of Inspection and Enforcement or of the appropriate Regional Office determines, with respect to a complaint under § 19.16, that an inspection is not warranted because there are no reasonable grounds to believe that a violation exists or has occurred, he shall notify the complainant in writing of such determination. The complainant may obtain review of such determination by submitting a written statement of posi-

tion with the Executive Director for Operations, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, who will provide the licensee with a copy of such statement by certified mail, excluding, at the request of the complainant, the name of the complainant. The licensee may submit an opposing written statement of position with the Executive Director for Operations who will provide the complainant with a copy of such statement by certified mail. Upon the request of the complainant, the Executive Director for Operations or his designee may hold an informal conference in which the complainant and the licensee may orally present their views. An informal conference may also be held at the request of the licensee, but disclosure of the identity of the complainant will be made only following receipt of written authorization from the complainant. After considering all written and oral views presented, the Executive Director for Operations shall affirm, modify, or reverse the determination of the Director of Inspection and Enforcement or of the appropriate Regional Office and furnish the complainant and the licensee a written notification of his decision and the reason therefor.

(b) If the Director of Inspection and Enforcement or of the appropriate Regional Office determines that an inspection is not warranted because the requirements of § 19.16(a) have not been met, he shall notify the complainant in writing of such determination. Such determination shall be without prejudice to the filing of a new complaint meeting the requirements of § 19.16(a).

38 FR 22217

§ 19.30 Violations.

40 FR 8774

An injunction or other court order may be obtained prohibiting any violation of any provision of the Act or Title II of the Energy Reorganization Act of 1974, or any regulation or order issued thereunder.

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A court order may be obtained for the payment of a civil penalty imposed pursuant to section 234 of the Act for violation of section 53, 57, 62, 63, 81, 82, 101, 103, 104, 107, or 109 of the Act or any rule, regulation, or order issued thereunder, or any term, condition or limitation of any license issued thereunder, or for any violation for which a license may be revoked under section 186 of the Act. Any person who willfully violates any provision of the Act or any regulation or order issued thereunder may be guilty of a crime and, upon conviction, may be punished by fine or imprisonment or both, as provided by law.

§ 19.31 Application for exemptions.

The Commission may, upon application by any licensee or upon its own initiative, grant such exemptions from the requirements of the regulations in this part as it determines are authorized by law and will not result in undue hazard to life or property.

§ 19.32 Discrimination prohibited.

40 FR 8774

No person shall on the ground of sex be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity licensed by the Nuclear Regulatory Commission. This provision will be enforced through agency provisions and rules similar to those already established, with respect to racial and other discrimination, under title VI of the Civil Rights Act of 1964. This remedy is not exclusive, however, and will not prejudice or cut off any other legal remedies available to a discriminatee.

PART 20

STANDARDS FOR PROTECTION AGAINST RADIATION

GENERAL PROVISIONS

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Appendix B—Concentrations in air and water above natural background.
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Appendix D—United States Nuclear Regulatory Commission Inspection and Enforcement Regional Offices.

AUTHORITY: The provisions of this Part 20 issued under secs. 53, 63, 65, 81, 103, 104, 161, 68 Stat. 930, 933, 935, 936, 937, 948, as amended; 42 U.S.C. 2073, 2093, 2095, 2111, 2133, 2134, 2201. For the purposes of sec. 223, 68 Stat. 958, as amended; 42 U.S.C. 2273, §§ 20.401-20.409, issued under sec. 161 o., 68 Stat. 950, as amended; 42 U.S.C. 2201 (o). Secs. 202, 206, Pub. L. 93-438, 88 Stat. 1244, 1246 (42 U.S.C. 5842, 5846).

§ 20.1 Purpose.

(a) The regulations in this part establish standards for protection against radiation hazards arising out of activities under licenses issued by the Nuclear Regulatory Commission and are issued pursuant to the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974.

(b) The use of radioactive material or other sources of radiation not licensed by the Commission is not subject to the regulations in this part. However, it is the purpose of the regulations in this part to control the possession, use, and transfer of licensed material by any licensee in such a manner that exposure to such material and to radiation from such material, when added to exposures to unlicensed radioactive material and to other unlicensed sources of radiation in the possession of the licensee, and to radiation therefrom, does not exceed the standards of radiation protection prescribed in the regulations in this part.

(c) In accordance with recommendations of the Federal Radiation Council, approved by the President, persons engaged in activities under licenses issued by the Nuclear Regulatory Commission pursuant to the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974 should, in addition to complying with the requirements set forth in this part, make every reasonable effort to maintain radiation exposures, and releases of radioactive materials in effluents to unrestricted areas, as low as is reasonably achievable. The term "as low as is reasonably achievable" means as low as is reasonably achievable taking into account the state of technology, and the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to the utilization of atomic energy in the public interest.

§ 20.2 Scope.

The regulations in this part apply to all persons who receive, possess, use, or transfer material licensed pursuant to the regulations in Parts 30 through 35, 40, or 70 of this chapter, including persons licensed to operate a production or utilization facility pursuant to Part 50 of this chapter.

§ 20.3 Definitions.

(a) As used in this part:

(1) "Act" means the Atomic Energy Act of 1954 (68 Stat. 919) including any amendments thereto;

(2) "Airborne radioactive material" means any radioactive material dispersed in the air in the form of dusts, fumes, mists, vapors, or gases;

(3) "Byproduct material" means any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material;

(4) "Calendar quarter" means not less than 12 consecutive weeks nor more than 14 consecutive weeks. The first calendar quarter of each year shall begin in January and subsequent calendar quarters shall be such that no day is included in more than one calendar quarter or omitted from inclusion within a calendar quarter. No licensee shall change the method observed by him of determining calendar quarters except at the beginning of a calendar year.

(5) "Commission" means the Nuclear Regulatory Commission or its duly authorized representatives;

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(6) "Government agency" means any executive department, commission, independent establishment, corporation, wholly or partly owned by the United States of America which is an instrumentality of the United States, or any board, bureau, division, service, office, officer, authority, administration, or other establishment in the executive branch of the Government;

(7) "Individual" means any human being;

(8) "Licensed material" means source material, special nuclear material, or byproduct material received, possessed, used, or transferred under a general or specific license issued by the Commission pursuant to the regulations in this chapter;

(9) "License" means a license issued under the regulations in Part 30, 40, or 70 of this chapter. "Licensee" means the holder of such license;

(10) "Occupational dose" includes exposure of an individual to radiation (i) in a restricted area; or (ii) in the course of employment in which the individual's duties involve exposure to radiation; provided, that "occupational dose" shall not be deemed to include any exposure of an individual to radiation for the purpose of medical diagnosis or medical therapy of such individual.

(11) "Person" means (i) any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency other than the Commission or the Administration (except that the Administration shall be considered a person within the meaning of the regulations in this part to the extent that its facilities and activities are subject to the licensing and related regulatory authority of the Commission pursuant to section 202 of the Energy Reorganization Act of 1974 (88 Stat. 1244)), any State, any foreign government or nation or any political subdivision of any such government or nation, or other entity; and (ii) any legal successor, representative, agent, or agency of the foregoing.

(12) "Radiation" means any or all of the following: alpha rays, beta rays, gamma rays, X-rays, neutrons, high-speed electrons, high-speed protons, and other atomic particles; but not sound or radio waves, or visible, infrared, or ultraviolet light;

(13) "Radioactive material" includes any such material whether or not subject to licensing control by the Commission;

(14) "Restricted area" means any area access to which is controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials. "Restricted area" shall not include any areas used as residential quarters, although a separate room or rooms in a residential building may be set apart as a restricted area;

(15) "Source material" means (i) uranium or thorium, or any combination thereof, in any physical or chemical form; or (ii) ores which contain by weight one-twentieth of one percent (0.05%) or more of a. uranium, b. thorium or c. any combination thereof. Source material does not include special nuclear material.

(16) "Special nuclear material" means (i) plutonium, uranium 233, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the Commission, pursuant to the provisions of section 51 of the act, determines to be special nuclear material, but does not include source material; or (ii) any material artificially enriched by any of the foregoing but does not include source material;

(17) "Unrestricted area" means any area access to which is not controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials, and any area used for residential quarters.

(18) "Administration[1]" means the Energy Research and Development Administration or its duly authorized representatives.

(b) Definitions of certain other words and phrases as used in this part are set forth in other sections, including:

(1) "Airborne radioactivity area" defined in § 20.203;

(2) "Radiation area" and "high radiation area" defined in § 20.202;

(3) "Personnel monitoring equipment" defined in § 20.202;

(4) "Survey" defined in § 20.201;

(5) Units of measurement of dose (rad, rem) defined in § 20.4;

(6) Units of measurement of radioactivity defined in § 20.5.

§ 20.4 Units of radiation dose.

(a) "Dose," as used in this part, is the quantity of radiation absorbed, per unit of mass, by the body or by any portion of the body. When the regulations in this part specify a dose during a period of time, the dose means the total quantity of radiation absorbed, per unit of mass, by the body or by any portion of the body during such period of time. Several different units of dose are in current use. Definitions of units as used in this part are set forth in paragraphs (b) and (c) of this section.

(b) The rad, as used in this part, is a measure of the dose of any ionizing radiation to body tissues in terms of the energy absorbed per unit mass of the tissue. One rad is the dose corresponding to the absorption of 100 ergs per gram of tissue. (One millirad (mrad) = 0.001 rad.)

(c) The rem, as used in this part, is a measure of the dose of any ionizing radiation to body tissue in terms of its estimated biological effect relative to a dose of one roentgen (r) of X-rays. (One millirem (mrem) = 0.001 rem.) The relation of the rem to other dose units depends upon the biological effect under consideration and upon the conditions of irradiation. For the purpose of the regulations in this part, any of the following is considered to be equivalent to a dose of one rem:

(1) A dose of 1 r due to X- or gamma radiation;

(2) A dose of 1 rad due to X-, gamma, or beta radiation;

(3) A dose of 0.1 rad due to neutrons or high energy protons;

(4) A dose of 0.05 rad due to particles heavier than protons and with sufficient energy to reach the lens of the eye;

If it is more convenient to measure the neutron flux, or equivalent, than to determine the neutron dose in rads, as provided in subparagraph (3) of this paragraph, one rem of neutron radiation may, for purposes of the regulations in this part, be assumed to be equivalent to 14 million neutrons per square centimeter incident upon the body; or, if there exists sufficient information to estimate with reasonable accuracy the approximate distribution in energy of the neutrons, the incident number of neutrons per square centimeter equivalent to one rem may be estimated from the following table:

NEUTRON FLUX DOSE EQUIVALENTS

Neutron energy (Mev)	Number of neutrons per square centimeter equivalent to a dose of 1 rem (neutrons/cm²)	Average flux to deliver 100 millirem in 40 hours (neutrons/cm² per sec.)
Thermal	970×10⁶	680
0.0001	720×10⁶	500
0.005	820×10⁶	570
0.02	400×10⁶	280
0.1	120×10⁶	80
0.5	43×10⁶	30
1.0	26×10⁶	18
2.5	29×10⁶	20
5.0	24×10⁶	16
7.5	24×10⁶	17
10	24×10⁶	17
10 to 30	14×10⁶	10

(d) For determining exposures to X or gamma rays up to 3 Mev, the dose limits specified in §§ 20.101 to 20.104, inclusive, may be assumed to be equivalent to the "air dose". For the purpose of this part "air dose" means that the dose is measured by a properly calibrated appropriate instrument in air at or near the body surface in the region of highest dosage rate.

§ 20.5 Units of radioactivity.

(a) Radioactivity is commonly, and for purposes of the regulations in this part shall be, measured in terms of disintegrations per unit time or in curies. One curie = 3.7×10^{10} disintegrations per second (dps) = 2.2×10^{12} disintegrations per minute (dpm). Commonly used submultiples of the curie are the millicurie and the microcurie:

(1) One millicurie (mCi) [1] = 0.001 curie (Ci) [1] = 3.7×10^{7} dps.

(2) One microcurie (μCi) [1] = 0.000001 curie = 3.7×10^{4} dps.

[1] Wherever possible, the appropriate unit should be written out as "curie(s)," "millicurie(s)," or "microcurie(s)," and the abbreviations should not be used.

(b) [Deleted 40 FR 50704.]

(c) [Deleted 39 FR 23990.]

25 FR 10914

§ 20.6 Interpretations.

Except as specifically authorized by the Commission in writing, no interpretation of the meaning of the regulations in this part by any officer or employee of the Commission other than a written interpretation by the General Counsel will be recognized to be binding upon the Commission.

40 FR 8774

§ 20.7 Communications.

Except where otherwise specified in this part, all communications and reports concerning the regulations in this part should be addressed to the Executive Director for Operations, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555. Communications, reports, and applications may be delivered in person at the Commission's offices at 1717 H Street NW., Washington, D.C.; or at 7920 Norfolk Avenue, Bethesda, Maryland.

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** PERMISSIBLE DOSES, LEVELS, AND CONCENTRATIONS

§ 20.101 Exposure of individuals to radiation in restricted areas.

(a) Except as provided in paragraph (b) of this section, no licensee shall possess, use, or transfer licensed material in such a manner as to cause any individual in a restricted area to receive in any period of one calendar quarter from radioactive material and other sources of radiation in the licensee's possession a dose in excess of the limits specified in the following table:

Rems per calendar quarter

1. Whole body; head and trunk; active blood-forming organs; lens of eyes; or gonads	1¼
2. Hands and forearms; feet and ankles	18¾
3. Skin of whole body	7½

(b) A licensee may permit an individual in a restricted area to receive a dose to the whole body greater than that permitted under paragraph (a) of this section, provided:

(1) During any calendar quarter the dose to the whole body from radioactive material and other sources of radiation in the licensee's possession shall not exceed 3 rems; and

(2) The dose to the whole body, when added to the accumulated occupational dose to the whole body, shall not exceed 5 (N−18) rems where "N" equals the individual's age in years at his last birthday; and

(3) The licensee has determined the individual's accumulated occupational dose to the whole body on Form NRC-4, or on a clear and legible record containing all the information required in that form; and has otherwise complied with the requirements of § 20.102. As used in paragraph (b), "Dose to the whole body" shall be deemed to include any dose to the whole body, gonads, active blood-forming organs, head and trunk, or lens of eye.

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§ 20.102 Determination of accumulated dose.

(a) This section contains requirements which must be satisfied by licensees who propose, pursuant to paragraph (b) of § 20.101, to permit individuals in a restricted area to receive exposure to radiation in excess of the limits specified in paragraph (a) of § 20.101.

(b) Before permitting any individual in a restricted area to receive exposure to radiation in excess of the limits specified in paragraph (a) of § 20.101, each licensee shall:

(1) Obtain a certificate on Form NRC-4, or on a clear and legible record containing all the information required in that form, signed by the individual showing each period of time after the individual attained the age of 18 in which the individual received an occupational dose of radiation; and

(2) Calculate on Form NRC-4 in accordance with the instructions appearing therein, or on a clear and legible record containing all the information required in that form, the previously accumulated occupational dose received by the individual and the additional dose allowed for that individual under § 20.101(b).

(c)(1) In the preparation of Form NRC-4, or a clear and legible record containing all the information required in that form, the licensee shall make a reasonable effort to obtain reports of the individual's previously accumulated occupational dose. For each period for which the licensee obtains such reports, the licensee shall use the dose shown in the report in preparing the form. In any case where a licensee is unable to obtain reports of the individual's occupational dose for a previous complete calendar quarter, it shall be assumed that the individual has received the occupational dose specified in whichever of the following columns apply:

Part of body	Column 1 Assumed exposure in rems for calendar quarters prior to Jan. 1, 1961	Column 2 Assumed exposure in rems for calendar quarters beginning on or after Jan. 1, 1961
Whole body, gonads, active blood-forming organs, head and trunk, lens of eye.	3¾	1¼

(2) The licensee shall retain and preserve records used in preparing Form NRC-4. If calculation of the individual's accumulated occupational dose for all periods prior to January 1, 1961 yields a result higher than the applicable accumulated dose value for the individual as of that date, as specified in paragraph (b) of § 20.101, the excess may be disregarded.

§ 20.103 Exposure of individuals to concentrations of radioactive material in restricted areas.

(a) No licensee shall possess, use or transfer licensed material in such a manner as to cause any individual in a restricted area to be exposed to airborne radioactive material possessed by the licensee in an average concentration in excess of the limits specified in Appendix B, Table I, of this part. "Expose" as used in this section means that the individual is present in an airborne concentration. No allowance shall be made for the use of protective clothing or equipment, or particle size, except as authorized by the Commission pursuant to paragraph (c) of this section.

(b) The limits given in Appendix B, Table I, of this part are based upon exposure to the concentrations specified for forty hours in any period of seven consecutive days. In any such period where the number of hours of exposure is less than forty, the limits specified in the table may be increased proportionately. In any such period where the number of hours of exposure is greater than forty, the limits specified in the table shall be decreased proportionately.

(c)(1) Except as authorized by the Commission pursuant to this paragraph, no allowance shall be made for particle size or the use of protective clothing or equipment in determining whether an individual is exposed to an airborne concentration in excess of the limits specified in Appendix B, Table I.

(2) The Commission may authorize a licensee to expose an individual in a restricted area to airborne concentrations in excess of the limits specified in Appendix B, Table I, upon receipt of an application demonstrating that the concentration is composed in whole or in part of particles of such size that such particles are not respirable; and that the individual will not inhale the concentrations in excess of the limits established in Appendix B, Table I. Each application under this subparagraph shall include an analysis of particle sizes in the concentrations; and a description

* The duration of sample collection and the duration of measurement should be sufficiently short compared to the time between collection and measurement, as not to have a statistically significant effect upon the results.

** Amended 36 FR 1464.

NOTE: *Amendments* made by 40 FR 50704 become effective 1/29/76.

of the methods used in determining the particle sizes.

(3) The Commission may authorize a licensee to expose an individual in a restricted area to airborne concentration in excess of the limits specified in Appendix B, Table I, upon receipt of an application demonstrating that the individual will wear appropriate protective equipment and that the individual will not inhale, ingest or absorb quantities of radioactive material in excess of those which might otherwise be permitted under this part for employees in restricted areas during a 40-hour week. Each application under this subparagraph shall contain the following information:

(i) A description of the protective equipment to be employed, including the efficiency of the equipment for the material involved;

(ii) Procedures for the fitting, maintenance and cleaning of the protective equipment; and

(iii) Procedures governing the use of the protective equipment, including supervisory procedures and length of time the equipment will be used by the individuals in each work week. The proposed periods for use of the equipment by any individual should not be of such duration as would discourage observance by the individual of the proposed procedures; and

(iv) The average concentrations present in the areas occupied by employees.

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§ 20.104 Exposure of minors.

No licensee shall possess, use or transfer licensed material in such a manner as to cause any individual within a restricted area who is under 18 years of age, to receive in any period of one calendar quarter from radioactive material and other sources of radiation in the licensee's possession a dose in excess of 10 percent of the limits specified in the table in paragraph (a) of § 20.101.

(b) No licensee shall possess, use or transfer licensed material in such a manner as to cause any individual within a restricted area, who is under 18 years of age to be exposed to airborne radioactive material possessed by the licensee in an average concentration in excess of the limits specified in Appendix B, Table II of this part. For purposes of this paragraph, concentrations may be averaged over periods not greater than a week.

(c) The provisions of paragraph (c) of § 20.103, shall apply to exposures subject to paragraph (b) of this section.

§ 20.105 Permissible levels of radiation in unrestricted areas.

(a) There may be included in any application for a license or for amendment of a license proposed limits upon levels of radiation in unrestricted areas resulting from the applicant's possession or use of radioactive material and other sources of radiation. Such applications should include information as to anticipated average radiation levels and anticipated occupancy times for each unrestricted area involved. The Commission will approve the proposed limits if the applicant demonstrates that the proposed limits are not likely to cause any individual to receive a dose to the whole body in any period of one calendar year in excess of 0.5 rem.

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(b) Except as authorized by the Commission pursuant to paragraph (a) of this section, no licensee shall possess, use or transfer licensed material in such a manner as to create in any unrestricted area from radioactive material and other sources of radiation in his possession:

(1) Radiation levels which, if an individual were continuously present in the area, could result in his receiving a dose in excess of two millirems in any one hour, or

(2) Radiation levels which, if an individual were continuously present in the area, could result in his receiving a dose in excess of 100 millirems in any seven consecutive days.

29 FR 14434

§ 20.106 Radioactivity in effluents to unrestricted areas.

(a) A licensee shall not possess, use, or transfer licensed material so as to release to an unrestricted area radioactive material in concentrations which exceed the limits specified in Appendix "B", Table II of this part, except as authorized pursuant to § 20.302 or paragraph (b) of this section. For purposes of this section concentrations may be averaged over a period not greater than one year.

(b) An application for a license or amendment may include proposed limits higher than those specified in paragraph (a) of this section. The Commission will approve the proposed limits if the applicant demonstrates:

(1) That the applicant has made a reasonable effort to minimize the radioactivity contained in effluents to unrestricted areas; and

(2) That it is not likely that radioactive material discharged in the effluent would result in the exposure of an individual to concentrations of radioactive material in air or water exceeding the limits specified in Appendix "B", Table II of this part.

(c) An application for higher limits pursuant to paragraph (b) of this section shall include information demonstrating that the applicant has made a reasonable effort to minimize the radioactivity discharged in effluents to unrestricted areas, and shall include, as pertinent:

(1) Information as to flow rates, total volume of effluent, peak concentration of each radionuclide in the effluent, and concentration of each radionuclide in the effluent averaged over a period of one year at the point where the effluent leaves a stack, tube, pipe, or similar conduit;

(2) A description of the properties of the effluents, including:

(i) chemical composition;

(ii) physical characteristics, including suspended solids content in liquid effluents, and nature of gas or aerosol for air effluents;

(iii) the hydrogen ion concentrations (p^H) of liquid effluents; and

(iv) the size range of particulates in effluents released into air.

(3) A description of the anticipated human occupancy in the unrestricted area where the highest concentration of radioactive material from the effluent is expected, and, in the case of a river or stream, a description of water uses downstream from the point of release of the effluent.

(4) Information as to the highest concentration of each radionuclide in an unrestricted area, including anticipated concentrations averaged over a period of one year:

(i) In air at any point of human occupancy; or

(ii) In water at points of use downstream from the point of release of the effluent.

(5) The background concentration of radionuclides in the receiving river or stream prior to the release of liquid effluent.

(6) A description of the environmental monitoring equipment, including sensitivity of the system, and procedures and calculations to determine concentrations of radionuclides in the unrestricted area and possible reconcentrations of radionuclides.

(7) A description of the waste treatment facilities and procedures used to reduce the concentration of radionuclides in effluents prior to their release.

29 FR 14434

(d) For the purposes of this section the concentration limits in Appendix "B", Table II of this part shall apply at the boundary of the restricted area. The concentration of radioactive material discharged through a stack, pipe or similar conduit may be determined with respect to the point where the material leaves the conduit. If the conduit discharges within the restricted area, the concentration at the boundary may be determined by applying appropriate factors for dilution, dispersion, or decay between the point of discharge and the boundary.

(e) In addition to limiting concentrations in effluent streams, the Commission may limit quantities of radioactive materials released in air or water during a specified period of time if it appears that the daily intake of radioactive material from air, water, or food by a suitable sample of an exposed population group, averaged over a period not exceeding one year, would otherwise exceed the daily intake resulting from continuous exposure to air or water containing one-third the concentration of radioactive materials specified in Appendix "B", Table II of this part.

(f) The provisions of this section do not apply to disposal of radioactive material into sanitary sewerage systems, which is governed by § 20.303

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§ 20.107 Medical diagnosis and therapy.

Nothing in the regulations in this part shall be interpreted as limiting the intentional exposure of patients to radiation for the purpose of medical diagnosis or medical therapy.

§ 20.108 Orders requiring furnishing of bio-assay services.

Where necessary or desirable in order to aid in determining the extent of an

individual's exposure to concentrations of radioactive material, the Commission may incorporate appropriate provisions in any license, directing the licensee to make available to the individual appropriate bio-assay services and to furnish a copy of the reports of such services to the Commission.

PRECAUTIONARY PROCEDURES

§ 20.201 Surveys.

(a) As used in the regulations in this part, "survey" means an evaluation of the radiation hazards incident to the production, use, release, disposal, or presence of radioactive materials or other sources of radiation under a specific set of conditions. When appropriate, such evaluation includes a physical survey of the location of materials and equipment, and measurements of levels of radiation or concentrations of radioactive material present.

(b) Each licensee shall make or cause to be made such surveys as may be necessary for him to comply with the regulations in this part.

§ 20.202 Personnel monitoring.

(a) Each licensee shall supply appropriate personnel monitoring equipment to, and shall require the use of such equipment by:

(1) Each individual who enters a restricted area under such circumstances that he receives, or is likely to receive, a dose in any calendar quarter in excess of 25 percent of the applicable value specified in paragraph (a) of § 20.101.

(2) Each individual under 18 years of age who enters a restricted area under such circumstances that he receives, or is likely to receive, a dose in any calendar quarter in excess of 5 percent of the applicable value specified in paragraph (a) of § 20.101.

(3) Each individual who enters a high radiation area.

(b) As used in this part,

(1) "Personnel monitoring equipment" means devices designed to be worn or carried by an individual for the purpose of measuring the dose received (e. g., film badges, pocket chambers, pocket dosimeters, film rings, etc.);

(2) "Radiation area" means any area, accessible to personnel, in which there exists radiation, originating in whole or in part within licensed material, at such levels that a major portion of the body could receive in any one hour a dose in excess of 5 millirem, or in any 5 consecutive days a dose in excess of 100 millirems;

(3) "High radiation area" means any area, accessible to personnel, in which there exists radiation originating in whole or in part within licensed material at such levels that a major portion of the body could receive in any one hour a dose in excess of 100 millirem.

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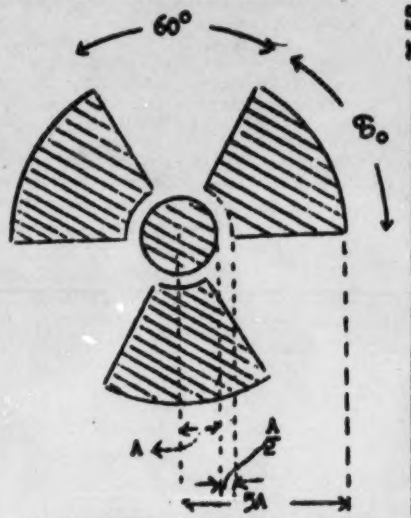
35 FR 5033

§ 20.203 Caution signs, labels, signals, and controls.

(a) *General.* (1) Except as otherwise authorized by the Commission, symbols prescribed by this section shall use the conventional radiation caution colors (magenta or purple on yellow background). The symbol prescribed by this section is the conventional three-bladed design:

RADIATION SYMBOL

1. Cross-hatched area is to be magenta or purple.
2. Background is to be yellow.



35 FR 5033

(2) In addition to the contents of signs and labels prescribed in this section, licensees may provide on or near such signs and labels any additional information which may be appropriate in aiding individuals to minimize exposure to radiation or to radioactive material.

(b) *Radiation areas.* Each radiation area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION[1]
RADIATION AREA

(c) *High radiation areas.* (1) Each high radiation area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION[1]
HIGH RADIATION AREA

(2) Each entrance or access point to a high radiation area shall be:

(i) Equipped with a control device which shall cause the level of radiation to be reduced below that at which an individual might receive a dose of 100 millirems in 1 hour upon entry into the area; or

(ii) Equipped with a control device which shall energize a conspicuous visible or audible alarm signal in such a manner that the individual entering the high radiation area and the licensee or a supervisor of the activity are made aware of the entry; or

(iii) Maintained locked except during periods when access to the area is required, with positive control over each individual entry.

(3) The controls required by subparagraph (2) of this paragraph shall be established in such a way that no individual will be prevented from leaving a high radiation area.

(4) In the case of a high radiation area established for a period of 30 days or less, direct surveillance to prevent unauthorized entry may be substituted for the controls required by subparagraph (2) of this paragraph.

(5) Any licensee, or applicant for a license, may apply to the Commission for approval of methods not included in subparagraphs (2) and (4) of this paragraph for controlling access to high radiation areas. The Commission will approve the proposed alternatives if the licensee or applicant demonstrates that the alternative methods of control will prevent unauthorized entry into a high radiation area, and that the requirement of subparagraph (3) of this paragraph is met.

(d) *Airborne radioactivity areas.* (1) As used in the regulations in this part, "airborne radioactivity area" means (i) any room, enclosure, or operating area in which airborne radioactive materials, composed wholly or partly of licensed material, exist in concentrations in excess of the amounts specified in Appendix B, Table I, Column 1 of this part; or (ii) any room, enclosure, or operating area in which airborne radioactive material composed wholly or partly of licensed material exists in concentrations which, averaged over the number of hours in any week during which individuals are in the area, exceed 25 percent of the amounts specified in Appendix B, Table I, Column 1 of this part.

(2) Each airborne radioactivity area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION[1]
AIRBORNE RADIOACTIVITY AREA

(e) *Additional requirements.* (1) Each area or room in which licensed material is used or stored and which contains any radioactive material (other than natural uranium or thorium) in an amount exceeding 10 times the quantity of such material specified in Appendix C of this part shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION[1]
RADIOACTIVE MATERIAL(S)

(2) Each area or room in which natural uranium or thorium is used or stored in an amount exceeding one-hundred times the quantity specified in Appendix C of this part shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION[1]
RADIOACTIVE MATERIAL(S)

(f) *Containers.* (1) Except as provided in subparagraph (3) of this paragraph, each container of licensed mate-

[1] Or "Danger."

rial shall bear a durable, clearly visible label identifying the radioactive contents.

(2) A label required pursuant to subparagraph (1) of this paragraph shall bear the radiation caution symbol and the words "CAUTION, RADIOACTIVE MATERIAL" or "DANGER, RADIOACTIVE MATERIAL". It shall also provide sufficient information[1] to permit individuals handling or using the containers, or working in the vicinity thereof, to take precautions to avoid or minimize exposures.

(3) Notwithstanding the provisions of subparagraph (1) of this paragraph, labeling is not required:

(i) For containers that do not contain licensed materials in quantities greater than the applicable quantities listed in Appendix C of this part.

(ii) For containers containing only natural uranium or thorium in quantities no greater than 10 times the applicable quantities listed in Appendix C of this part.

(iii) For containers that do not contain licensed materials in concentrations greater than the applicable concentrations listed in Column 2, Table I, Appendix B of this part.

(iv) For containers when they are attended by an individual who takes the precautions necessary to prevent the exposure of any individual to radiation or radioactive materials in excess of the limits established by the regulations in this part.

(v) For containers when they are in transport and packaged and labeled in accordance with regulations of the Department of Transportation.

(vi) For containers which are accessible[2] only to individuals authorized to handle or use them, or to work in the vicinity thereof, provided that the contents are identified to such individuals by a readily available written record.

(vii) For manufacturing or process equipment, such as nuclear reactors, reactor components, piping, and tanks.

[34 FR 19544]

[25 FR 10914]

§ 20.204 Same: exceptions.

Notwithstanding the provisions of § 20.203,

(a) A room or area is not required to be posted with a caution sign because of the presence of a sealed source provided the radiation level twelve inches from the surface of the source container or housing does not exceed five millirem per hour.

(b) Rooms or other areas in hospitals are not required to be posted with caution signs, and control of entrance or access thereto pursuant to § 20.203(c) is not required, because of the presence of patients containing byproduct material provided that there are personnel in attendance who will take the precautions necessary to prevent the exposure of any individual to radiation or radioactive material in excess of the limits established in the regulations in this part.

[39 FR 17972]

[35 FR 6033]

(c) Caution signs are not required to be posted at areas or rooms containing radioactive materials for periods of less than eight hours provided that (1) the materials are constantly attended during such periods by an individual who shall take the precautions necessary to prevent the exposure of any individual to radiation or radioactive materials in excess of the limits established in the regulations in this part and; (2) such area or room is subject to the licensee's control.

[25 FR 10914]

(d) A room or other area is not required to be posted with a caution sign, and control is not required for each entrance or access point to a room or other area which is a high radiation area solely because of the presence of radioactive materials prepared for transport and packaged and labeled in accordance with regulations of the Department of Transportation.

[35 FR 5033]

§ 20.205 Procedures for picking up, receiving, and opening packages.

(a) (1) Each licensee who expects to receive a package containing quantities of radioactive material in excess of the Type A quantities specified in paragraph (b) of this section shall:

(i) If the package is to be delivered to the licensee's facility by the carrier, make arrangements to receive the package when it is offered for delivery by the carrier; or

(ii) If the package is to be picked up by the licensee at the carrier's terminal, make arrangements to receive notification from the carrier of the arrival of the package, at the time of arrival.

(2) Each licensee who picks up a package of radioactive material from a carrier's terminal shall pick up the package expeditiously upon receipt of notification from the carrier of its arrival.

[39 FR 17972]

(b) (1) Each licensee, upon receipt of a package of radioactive material, shall monitor the external surfaces of the package for radioactive contamination caused by leakage of the radioactive contents, except:

(i) Packages containing no more than the exempt quantity specified in the table in this paragraph;

(ii) Packages containing no more than 10 millicuries of radioactive material consisting solely of tritium, carbon-14, sulfur-35, or iodine-125;

(iii) Packages containing only radioactive material as gases or in special form;

(iv) Packages containing only radioactive material in other than liquid form (including Mo-99/Tc-99m generators) and not exceeding the Type A quantity limit specified in the table in this paragraph; and

(v) Packages containing only radionuclides with half-lives of less than 30 days and a total quantity of no more than 100 millicuries.

The monitoring shall be performed as soon as practicable after receipt, but no later than three hours after the package is received at the licensee's facility if received during the licensee's normal working hours, or eighteen hours if received after normal working hours.

(2) If removable radioactive contamination in excess of 0.01 microcuries (22,000 disintegrations per minute) per 100 square centimeters of package surface is found on the external surfaces of the package, the licensee shall immediately notify the final delivering carrier and, by telephone and telegraph, mailgram, or facsimile,† the appropriate Nuclear Regulatory Commission Inspection and Enforcement Regional Office shown in Appendix D.

TABLE OF EXEMPT AND TYPE A QUANTITIES

Transport group[1]	Exempt quantity limit (in millicuries)	Type A quantity limit (in curies)
I	.01	0.001
II	0.1	0.100
III	1	3
IV	1	20
V	1	20
VI	1	1000
VII	10,000	1000
Special Form	1	20

[39 FR 17972]

(c) (1) Each licensee, upon receipt of a package containing quantities of radioactive material in excess of the Type A quantities specified in paragraph (b) of this section, other than those transported by exclusive use vehicle, shall monitor the radiation levels external to the package. The package shall be monitored as soon as practicable after receipt, but no later than three hours after the package is received at the licensee's facility if received during the licensee's normal working hours, or 18 hours if received after normal working hours.

(2) If radiation levels are found on the external surface of the package in excess of 200 millirem per hour, or at three feet from the external surface of the package in excess of 10 millirem per hour, the licensee shall immediately notify by telephone and telegraph, mailgram, or facsimile, the director of the appropriate NRC Regional Office listed in Appendix D, and the final delivering carrier.

[41 FR 16445]

(d) Each licensee shall establish and maintain procedures for safely opening packages in which licensed material is received, and shall assure that such procedures are followed and that due consideration is given to special instructions for the type of package being opened.

[39 FR 17972]

§ 20.206 Instruction of personnel.

Instructions required for individuals working in or frequenting any portion of a restricted area are specified in § 19.12 of this chapter.

[39 FR 22220]

[1] As appropriate, the information will include radiation levels, kinds of material, estimate of activity, date for which activity is estimated, mass enrichment, etc.

[2] For example, containers in locations such as water-filled canals, storage vaults, or hot cells.

Amended 34 FR 19546.

[1] The definitions of "transport group" and "special form" are specified in § 71.4 of this chapter.

†Amended 41 FR 16445.

40 FR 28670

§ 20.207 Storage and control of licensed materials in unrestricted areas.

(a) Licensed materials stored in an unrestricted area shall be secured from unauthorized removal from the place of storage.

(b) Licensed materials in an unrestricted area and not in storage shall be tended under the constant surveillance and immediate control of the licensee.

Waste Disposal

§ 20.301 General requirement.

No licensee shall dispose of licensed material except:

(a) By transfer to an authorized recipient as provided in the regulations in Part 30, 40, or 70 of this chapter, whichever may be applicable; or

(b) As authorized pursuant to § 20.302; or

(c) As provided in § 20.303 or § 20.304, applicable respectively to the disposal of licensed material by release into sanitary sewerage systems or burial in soil, or in § 20.106 (Radioactivity in Effluents to Unrestricted Areas).

25 FR 10814

§ 20.302 Method for obtaining approval of proposed disposal procedures.

*(a) Any licensee or applicant for a license may apply to the Commission for approval of proposed procedures to dispose of licensed material in a manner not otherwise authorized in the regulations in this chapter. Each application should include a description of the licensed material and any other radioactive material involved, including the quantities and kinds of such material and the levels of radioactivity involved, and the proposed manner and conditions of disposal. The application should also include an analysis and evaluation of pertinent information as to the nature of the environment, including topographical, geological, meteorological, and hydrological characteristics; usage of ground and surface waters in the general area; the nature and location of other potentially affected facilities; and procedures to be observed to minimize the risk of unexpected or hazardous exposures.

26 FR 362

*(b) The Commission will not approve any application for a license to receive licensed material from other persons for disposal on land not owned by the Federal government or by a State government.

26 FR 23138

(c) The Commission will not approve any application for a license for disposal of licensed material at sea unless the applicant shows that sea disposal offers less harm to man or the environment than other practical alternative methods of disposal.

25 FR 10814

§ 20.303 Disposal by release into sanitary sewerage systems.

No licensee shall discharge licensed material into a sanitary sewerage system unless:

(a) It is readily soluble or dispersible in water; and

(b) The quantity of any licensed or other radioactive material released into the system by the licensee in any one day does not exceed the larger of subparagraphs (1) or (2) of this paragraph:

(1) The quantity which, if diluted by the average daily quantity of sewage released into the sewer by the licensee, will result in an average concentration equal to the limits specified in Appendix B, Table I, Column 2 of this part; or

(2) Ten times the quantity of such material specified in Appendix C of this part; and

(c) The quantity of any licensed or other radioactive material released in any one month, if diluted by the average monthly quantity of water released by the licensee, will not result in an average concentration exceeding the limits specified in Appendix B, Table I, Column 2 of this part; and

(d) The gross quantity of licensed and other radioactive material released into the sewerage system by the licensee does not exceed one curie per year.

Excreta from individuals undergoing medical diagnosis or therapy with radioactive material shall be exempt from any limitations contained in this section.

25 FR 10814

§ 20.304 Disposal by burial in soil.

No licensee shall dispose of licensed material by burial in soil unless:

(a) The total quantity of licensed and other radioactive materials buried at any one location and time does not exceed, at the time of burial, 1,000 times the amount specified in Appendix C of this part; and

(b) Burial is at a minimum depth of four feet; and

(c) Successive burials are separated by distances of at least six feet and not more than 12 burials are made in any year.

§ 20.305 Treatment or disposal by incineration.

No licensee shall treat or dispose of licensed material by incineration except as specifically approved by the Commission pursuant to §§ 20.106(b) and 20.302.

Records, Reports, and Notification

§ 20.401 Records of surveys, radiation monitoring, and disposal.

(a) Each licensee shall maintain records showing the radiation exposures of all individuals for whom personnel monitoring is required under § 20.202 of the regulations in this part. Such records shall be kept on Form NRC-5, in accordance with the instructions contained in that form or on clear and legible records containing all the information required by Form NRC-5. The doses entered on the forms or records shall be for periods of time not exceeding one calendar quarter.

39 FR 17972

(b) Each licensee shall maintain records in the same units used in this part, showing the results of surveys required by § 20.201(b), monitoring required by §§ 20.205(b) and 20.205(c), and disposals made under §§ 20.302, 20.303, and 20.304.

(c) Records of individual exposure to radiation and to radioactive material which must be maintained pursuant to the provisions of paragraph (a) of this section and records of bio-assays, including results of whole body counting examinations, made pursuant to § 20.108 shall be preserved indefinitely or until the Commission authorizes their disposal. Records which must be maintained pursuant to this part may be maintained in the form of microfilms.

35 FR 6910

34 FR 7500

§ 20.402 Reports of theft or loss of licensed material.

(a) Each licensee shall report by telephone and telegraph, mailgram, or facsimile,† to the Director of the appropriate Nuclear Regulatory Commission Inspection and Enforcement Regional Office listed in Appendix D, immediately after its occurrence becomes known to the licensee, any loss or theft of licensed material in such quantities and under such circumstances that it appears to the licensee that a substantial hazard may result to persons in unrestricted areas.

41 FR 16445

(b) Each licensee who is required to make a report pursuant to paragraph (a) of this section shall, within thirty (30) days after he learns of the loss or theft, make a report in writing to the appropriate NRC Regional Office listed in Appendix D with copies to the Director of Inspection and Enforcement, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, setting forth the following information:

34 FR 7500

(1) A description of the licensed material involved, including kind, quantity, chemical, and physical form;

(2) A description of the circumstances under which the loss or theft occurred;

(3) A statement of disposition or probable disposition of the licensed material involved;

(4) Radiation exposures to individuals, circumstances under which the exposures occurred, and the extent of possible hazard to persons in unrestricted areas;

(5) Actions which have been taken, or will be taken, to recover the material; and

(6) Procedures or measures which have been or will be adopted to prevent a recurrence of the loss or theft of licensed material.

(c) Subsequent to filing the written report the licensee shall also report any substantive additional information on the loss or theft which becomes available to the licensee, within 30 days after he learns of such information.

(d) Any report filed with the Commission pursuant to this section shall be so prepared that names of individuals who may have received exposure to radiation are stated in a separate part of the report.

41 FR 16445

§ 20.403 Notifications of incidents.

(a) *Immediate notification.* Each licensee shall immediately notify by telephone and telegraph, mailgram, or facsimile, the Director of the appropriate NRC Regional Office listed in Appendix

*Redesignated 36 FR 23138.

†Amended 41 FR 16445.

D of any incident involving byproduct, source, or special nuclear material possessed by him and which may have caused or threatens to cause:

(1) Exposure of the whole body of any individual to 25 rems or more of radiation; exposure of the skin of the whole body of any individual of 150 rems or more of radiation; or exposure of the feet, ankles, hands or forearms of any individual to 375 rems or more of radiation; or

(2) The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 5,000 times the limits specified for such materials in Appendix B, Table II; or

(3) A loss of one working week or more of the operation of any facilities affected; or

(4) Damage to property in excess of $100,000.

(b) *Twenty-four hour notification.* Each licensee shall within 24 hours notify by telephone and telegraph, mailgram, or facsimile, the Director of the appropriate NRC Regional Office listed in Appendix D of any incident involving licensed material possessed by him and which may have caused or threatens to cause:

(1) Exposure of the whole body of any individual to 5 rems or more of radiation; exposure of the skin of the whole body of any individual to 30 rems or more of radiation; or exposure of the feet, ankles, hands, or forearms to 75 rems or more of radiation; or

(2) The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 500 times the limits specified for such materials in Appendix B, Table II; or

(3) A loss of one day or more of the operation of any facilities affected; or

(4) Damage to property in excess of $1,000.

(c) Any report filed with the Commission pursuant to this section shall be prepared so that names of individuals who have received exposure to radiation will be stated in a separate part of the report.

§ 20.404 [Deleted 38 FR 22220.]

§ 20.405 Reports of overexposures and excessive levels and concentrations.

(a) In addition to any notification required by § 20.403, each licensee shall make a report in writing within thirty (30) days to the appropriate NRC Regional Office listed in Appendix D with copies to the Director of Inspection and Enforcement, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, of:

(1) each exposure of an individual to radiation or concentrations of radioactive material in excess of any applicable limit in this part or in the licensee's license; (2) any incident for which notification is required by § 20.403; and (3) levels of radiation or concentrations of radioactive material (not involving excessive exposure of any individual) in an unrestricted area in excess of ten times any applicable limit set forth in this part or in the licensee's license.

Each report required under this paragraph shall describe the extent of exposure of persons to radiation or to radioactive material, including estimates of each individual's exposure as required by paragraph (b) of this section; levels of radiation and concentrations of radioactive material involved; the cause of the exposure, levels or concentrations; and corrective steps taken or planned to assure against a recurrence.

(b) Any report filed with the Commission pursuant to this section shall include for each individual exposed the name, social security number, and date of birth; and an estimate of the individual's exposure. The report shall be prepared so that this information is stated in a separate part of the report.

(c) [Deleted 38 FR 22220.]

§ 20.406 [Deleted 38 FR 22220.]

§ 20.407 Personnel exposure and monitoring reports.

(a) This section applies to each person licensed by the Commission or the Atomic Energy Commission to:

(1) Operate a nuclear reactor designed to produce electrical or heat energy pursuant to § 50.21(b) or § 50.22 of this chapter or a testing facility as defined in § 50.2(r) of this chapter;

(2) Possess or use byproduct material for purposes of radiography pursuant to Parts 30 and 34 of this chapter;

(3) Possess or use at any one time, for purposes of fuel processing, fabrication, or reprocessing, special nuclear material in a quantity exceeding 5,000 grams of contained uranium-235, uranium-233, or plutonium or any combination thereof pursuant to Part 70 of this chapter; or

(4) Possess or use at any one time, for processing or manufacturing for distribution pursuant to Part 30, 32, or 33 of this chapter, byproduct material in quantities exceeding anyone of the following quantities:

Radionuclide[1]	*Quantity in curies*
Cesium-137	1
Cobalt-60	1
Gold-198	100
Iodine-131	1
Iridium-192	10
Krypton-85	1,000
Promethium-147	10
Technetium-99m	1,000

(b) Each person described in paragraph (a) of this section shall, within the first quarter of each calendar year, submit to the Director of Inspection and Enforcement, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555,† the following reports, applicable to the described licensed activities covering the preceding calendar year:[2]

(1) A report of either (i) the total number of individuals for whom personnel monitoring was required under §§ 20.202(a) or 34.33(a) of this chapter during the calendar year, or (ii) the total number of individuals for whom personnel monitoring was provided during the calendar year; *Provided*, that such total includes at least the number of individuals required to be reported under paragraph (b)(1)(i) of this section. The report shall indicate whether it is submitted in accordance with paragraph (b)(1)(i) or (ii) of this section.

(2) A statistical summary report of the personnel monitoring information recorded by the licensee for individuals for whom personnel monitoring was either required or provided, as described in § 20.407(b)(1), indicating the number of individuals whose total whole body exposure recorded during the previous calendar year was in each of the following estimated exposure ranges:

Estimated Whole Body Exposure Range (Rems)[3]	*Number of individuals in each range*
No measurable exposure	
Measurable exposure less than 0.1	
0.1 to 0.25	
0.25 to 0.5	
0.5 to 0.75	
0.75 to 1	
1 to 2	
2 to 3	
3 to 4	
4 to 5	
5 to 6	
6 to 7	
7 to 8	
8 to 9	
9 to 10	
10 to 11	
11 to 12	
13+	

The low exposure range data are required in order to obtain better information about the exposures actually recorded. This section does not require improved measurements.

§ 20.408 Reports of personnel exposure on termination of employment or work.

When an individual terminates employment with a licensee subject to § 20.407, or an individual assigned to work in such a licensee's facility, but not employed by the licensee, completes his work assignment in the licensee's facility, the licensee shall furnish* to the Director of Inspection and Enforcement,† U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, a report of the individual's exposure to radiation and radioactive material, incurred during the

[1] The Commission may require, as a license condition, or by rule, regulation or order pursuant to § 20.502, reports from licensees who are licensed to use radionuclides not on this list, in quantities sufficient to cause comparable radiation levels.

†Amended 41 FR 16445.

[2] A licensee whose license expires or terminates prior to, or on the last day of the calendar year, shall submit reports at the expiration or termination of the license, covering that part of the year during which the license was in effect.

[3] Individual values exactly equal to the values separating Exposure Ranges shall be reported in the higher range.

* Amended 38 FR 22220.

34 FR 5254

period of employment or work assignment in the licensee's facility, containing information recorded by the licensee pursuant to §§ 20.401(a) and 20.408. Such report shall be furnished within 30 days after the exposure of the individual has been determined by the licensee or 90 days after the date of termination of employment or work assignment, whichever is earlier.

39 FR 22220

§ 20.409 Notifications and reports to individuals.

(a) Requirements for notifications and reports to individuals of exposure to radiation or radioactive material are specified in § 19.13 of this chapter.

(b) When a licensee is required pursuant to §§ 20.405 or 20.408 to report to the Commission any exposure of an individual to radiation or radioactive material, the licensee shall also notify the individual. Such notice shall be transmitted at a time not later than the transmittal to the Commission, and shall comply with the provisions of § 19.13(a) of this chapter.

EXCEPTIONS AND ADDITIONAL REQUIREMENTS

25 FR 10914

§ 20.501 Applications for exemptions.

The Commission may, upon application by any licensee or upon its own initiative, grant such exemptions from the requirements of the regulations in this part as it determines are authorized by law and will not result in undue hazard to life or property.

§ 20.502 Additional requirements.

The Commission may, by rule, regulation, or order, impose upon any licensee such requirements, in addition to those established in the regulations in this part, as it deems appropriate or necessary to protect health or to minimize danger to life or property.

40 FR 8774

§ 20.601 Violations.

An injunction or other court order may be obtained prohibiting any violation of any provision of the Atomic Energy Act of 1954, as amended, or Title II of the Energy Reorganization Act of 1974, or any regulation or order issued thereunder. A court order may be obtained for the payment of a civil penalty imposed pursuant to section 234 of the Act for violation of section 53, 57, 62, 63, 81, 82, 101, 103, 104, 107, or 109 of the Act, or section 206 of the Energy Reorganization Act of 1974, or any rule, regulation, or order issued thereunder, or any term, condition, or limitation of any license issued thereunder, or for any violation for which a license may be revoked under section 186 of the Act. Any person who willfully violates any provision of the Act or any regulation or order issued thereunder may be guilty of a crime and, upon conviction, may be punished by fine or imprisonment or both, as provided by law.

APPENDIX A [Reserved]

APPENDIX B

Concentrations in Air and Water Above Natural Background

(See footnotes on page 20-15)

Element (atomic number)	Isotope [1]	†	Table I, Column 1: Air (μCi/ml)	Table I, Column 2: Water (μCi/ml)	Table II, Column 1: Air (μCi/ml)	Table II, Column 2: Water (μCi/ml)
Actinium (89)	Ac 227	S	2×10^{-12}	6×10^{-3}	8×10^{-14}	2×10^{-4}
		I	3×10^{-11}	9×10^{-3}	9×10^{-13}	3×10^{-4}
	Ac 228	S	8×10^{-8}	3×10^{-3}	3×10^{-9}	9×10^{-5}
		I	2×10^{-8}	3×10^{-3}	6×10^{-10}	9×10^{-5}
Americium (95)	Am 241	S	6×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
		★ I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}
	Am 242m	S	6×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
		I	3×10^{-10}	3×10^{-3}	9×10^{-12}	9×10^{-5}
	Am 242	S	4×10^{-8}	4×10^{-3}	1×10^{-9}	1×10^{-4}
		I	5×10^{-8}	4×10^{-3}	2×10^{-9}	1×10^{-4}
	Am 243	S	6×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}
	Am 244	S	4×10^{-8}	1×10^{-1}	1×10^{-7}	5×10^{-3}
		I	2×10^{-8}	1×10^{-1}	8×10^{-7}	5×10^{-3}
Antimony (51)	Sb 122	S	2×10^{-7}	8×10^{-4}	6×10^{-9}	3×10^{-5}
		I	1×10^{-7}	8×10^{-4}	5×10^{-9}	3×10^{-5}
	Sb 124	S	2×10^{-7}	7×10^{-4}	5×10^{-9}	2×10^{-5}
		I	2×10^{-8}	7×10^{-4}	7×10^{-10}	2×10^{-5}
	Sb 125	S	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	3×10^{-8}	3×10^{-3}	9×10^{-10}	1×10^{-4}
Argon (18)	A 37	Sub[2]	6×10^{-3}	----------	1×10^{-4}	----------
	A 41	Sub	2×10^{-6}	----------	4×10^{-8}	----------
Arsenic (33)	As 73	S	2×10^{-6}	1×10^{-2}	7×10^{-8}	5×10^{-4}
		I	4×10^{-7}	1×10^{-2}	1×10^{-8}	5×10^{-4}
	As 74	S	3×10^{-7}	2×10^{-3}	1×10^{-8}	5×10^{-5}
		I	1×10^{-7}	2×10^{-3}	4×10^{-9}	5×10^{-5}
	As 76	S	1×10^{-7}	4×10^{-4}	4×10^{-9}	2×10^{-5}
		I	1×10^{-7}	4×10^{-4}	3×10^{-9}	2×10^{-5}
	As 77	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	8×10^{-5}
		I	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}
Astatine (85)	At 211	S	7×10^{-9}	3×10^{-5}	2×10^{-10}	2×10^{-6}
		I	3×10^{-8}	3×10^{-5}	1×10^{-9}	7×10^{-6}
Barium (56)	Ba 131	S	1×10^{-6}	5×10^{-3}	4×10^{-8}	2×10^{-4}
		I	4×10^{-7}	5×10^{-3}	1×10^{-8}	2×10^{-4}
	Ba 140	S	1×10^{-7}	8×10^{-4}	4×10^{-9}	3×10^{-5}
		I	4×10^{-8}	7×10^{-4}	1×10^{-9}	2×10^{-5}
Berkelium (97)	Bk 249	S	9×10^{-10}	2×10^{-2}	3×10^{-11}	6×10^{-4}
		I	1×10^{-7}	2×10^{-2}	4×10^{-9}	6×10^{-4}
	Bk 250	S	1×10^{-7}	6×10^{-3}	5×10^{-9}	2×10^{-4}
		I	1×10^{-6}	6×10^{-3}	4×10^{-8}	2×10^{-4}
Beryllium (4)	Be 7	S	6×10^{-6}	5×10^{-3}	2×10^{-7}	2×10^{-4}
		I	1×10^{-6}	5×10^{-3}	4×10^{-8}	2×10^{-4}
Bismuth (83)	Bi 206	S	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
		I	1×10^{-7}	1×10^{-3}	5×10^{-9}	4×10^{-5}
	Bi 207	S	2×10^{-7}	2×10^{-3}	6×10^{-9}	6×10^{-5}
		I	1×10^{-7}	2×10^{-3}	5×10^{-10}	6×10^{-5}
	Bi 210	S	6×10^{-9}	1×10^{-3}	2×10^{-10}	4×10^{-5}
		I	6×10^{-9}	1×10^{-3}	2×10^{-10}	4×10^{-5}
	Bi 212	S	1×10^{-7}	1×10^{-3}	3×10^{-9}	4×10^{-5}
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-5}

APPENDIX B

Concentrations in Air and Water Above Natural Background—Continued

(See footnotes on page 20-15)

Element (atomic number)	Isotope [1]	†	Table I, Column 1: Air (μCi/ml)	Table I, Column 2: Water (μCi/ml)	Table II, Column 1: Air (μCi/ml)	Table II, Column 2: Water (μCi/ml)
Bromine (35)	Br 82	S	1×10^{-6}	8×10^{-3}	4×10^{-8}	3×10^{-4}
		I	2×10^{-7}	1×10^{-2}	6×10^{-9}	4×10^{-4}
Cadmium (48)	Cd 109	S	3×10^{-8}	5×10^{-3}	2×10^{-9}	2×10^{-4}
		I	7×10^{-8}	5×10^{-3}	3×10^{-9}	2×10^{-4}
	Cd 115m	S	4×10^{-8}	7×10^{-4}	1×10^{-9}	3×10^{-5}
		I	4×10^{-8}	7×10^{-4}	1×10^{-9}	3×10^{-5}
	Cd 115	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	3×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
Calcium (20)	Ca 45	S	3×10^{-8}	3×10^{-4}	1×10^{-9}	9×10^{-6}
		I	1×10^{-7}	5×10^{-4}	4×10^{-9}	2×10^{-5}
	Ca 47	S	2×10^{-7}	1×10^{-3}	6×10^{-9}	3×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	3×10^{-5}
Californium (98)	Cf 249	S	2×10^{-12}	1×10^{-4}	5×10^{-14}	4×10^{-6}
		I	1×10^{-10}	7×10^{-4}	3×10^{-12}	2×10^{-5}
	Cf 250	S	5×10^{-12}	4×10^{-4}	2×10^{-13}	1×10^{-5}
		I	1×10^{-10}	7×10^{-4}	3×10^{-12}	3×10^{-5}
	Cf 251	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	4×10^{-6}
		I	1×10^{-10}	8×10^{-4}	3×10^{-12}	3×10^{-5}
	Cf 252	S	4×10^{-12}	3×10^{-4}	2×10^{-13}	7×10^{-6}
		★ I	3×10^{-11}	2×10^{-3}	1×10^{-12}	7×10^{-5}
	Cf 253	S	8×10^{-12}	4×10^{-4}	3×10^{-13}	1×10^{-5}
		I	8×10^{-10}	4×10^{-4}	3×10^{-11}	1×10^{-5}
	Cf 254	S	5×10^{-12}	4×10^{-4}	2×10^{-13}	1×10^{-5}
		I	5×10^{-10}	4×10^{-4}	2×10^{-11}	1×10^{-5}
Carbon (6)	C 14	S	4×10^{-7}	2×10^{-3}	1×10^{-7}	8×10^{-5}
	(CO_2)	Sub	5×10^{-7}	----------	1×10^{-7}	----------
Cerium (58)	Ce 141	S	4×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
		I	2×10^{-7}	3×10^{-3}	8×10^{-9}	9×10^{-5}
	Ce 143	S	3×10^{-7}	1×10^{-3}	9×10^{-9}	4×10^{-5}
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-5}
	Ce 144	S	1×10^{-8}	3×10^{-4}	3×10^{-10}	1×10^{-5}
		I	6×10^{-8}	3×10^{-4}	2×10^{-9}	1×10^{-5}
Cesium (55)	Cs 131	S	1×10^{-6}	7×10^{-3}	4×10^{-8}	2×10^{-4}
		I	3×10^{-6}	3×10^{-3}	1×10^{-7}	9×10^{-5}
	Cs 134m	S	4×10^{-6}	2×10^{-1}	1×10^{-7}	6×10^{-3}
		I	6×10^{-6}	3×10^{-2}	2×10^{-7}	1×10^{-3}
	Cs 134	S	4×10^{-8}	2×10^{-4}	1×10^{-9}	9×10^{-6}
		I	1×10^{-8}	1×10^{-4}	4×10^{-10}	4×10^{-6}
	Cs 135	S	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	9×10^{-8}	7×10^{-4}	3×10^{-9}	2×10^{-5}
	Cs 136	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	9×10^{-5}
		I	2×10^{-7}	2×10^{-3}	6×10^{-9}	6×10^{-5}
	Cs 137	S	6×10^{-8}	4×10^{-4}	2×10^{-9}	2×10^{-5}
		I	1×10^{-8}	1×10^{-4}	5×10^{-10}	4×10^{-6}
Chlorine (17)	Cl 36	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}
		I	2×10^{-6}	2×10^{-3}	8×10^{-8}	6×10^{-5}
	Cl 38	S	3×10^{-6}	1×10^{-2}	9×10^{-8}	4×10^{-4}
		I	2×10^{-6}	1×10^{-2}	7×10^{-8}	4×10^{-4}
Chromium (24)	Cr 51	S	1×10^{-6}	8×10^{-3}	4×10^{-8}	3×10^{-4}
		I	2×10^{-6}	8×10^{-3}	6×10^{-8}	2×10^{-4}

Apr. 30, 1962; 25 FR 10914; 10 CFR Ch. I (1-1-63 Edition)

APPENDIX B

Concentrations in Air and Water Above Natural Background—Continued

(See footnotes on page 20-15)

Element (atomic number)	Isotope [1]	†	Table I Column 1 Air (μCi/ml)	Table I Column 2 Water (μCi/ml)	Table II Column 1 Air (μCi/ml)	Table II Column 2 Water (μCi/ml)
Cobalt (27)	Co 57	S	3×10^{-6}	2×10^{-3}	1×10^{-7}	5×10^{-4}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-4}
	Co 58m	S	2×10^{-5}	8×10^{-3}	6×10^{-7}	3×10^{-3}
		I	9×10^{-6}	6×10^{-3}	3×10^{-7}	2×10^{-3}
	Co 58	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-3}
		I	5×10^{-6}	3×10^{-3}	2×10^{-7}	9×10^{-4}
	Co 60	S	3×10^{-7}	1×10^{-3}	1×10^{-8}	5×10^{-4}
		I	9×10^{-6}	1×10^{-3}	3×10^{-10}	3×10^{-4}
Copper (29)	Cu 64	S	2×10^{-6}	1×10^{-3}	7×10^{-8}	3×10^{-4}
		I	1×10^{-6}	6×10^{-4}	4×10^{-8}	2×10^{-4}
Curium (96)	Cm 242	S	1×10^{-10}	7×10^{-4}	4×10^{-12}	2×10^{-4}
		I	2×10^{-10}	7×10^{-4}	6×10^{-12}	2×10^{-4}
	Cm 243	S	6×10^{-12}	1×10^{-4}	2×10^{-13}	5×10^{-5}
		I	1×10^{-10}	7×10^{-4}	3×10^{-12}	2×10^{-4}
	Cm 244	S	9×10^{-12}	2×10^{-4}	3×10^{-13}	7×10^{-5}
		I	1×10^{-10}	8×10^{-4}	3×10^{-12}	3×10^{-4}
	Cm 245	S	5×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-5}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-4}
	Cm 246	S	5×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-5}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-4}
	Cm 247	S	5×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-5}
		I	1×10^{-10}	6×10^{-4}	4×10^{-12}	2×10^{-4}
	Cm 248	S	6×10^{-13}	1×10^{-4}	2×10^{-14}	4×10^{-5}
		I	1×10^{-11}	4×10^{-4}	4×10^{-13}	1×10^{-4}
	Cm 249	S	1×10^{-5}	6×10^{-3}	4×10^{-7}	2×10^{-3}
		I	1×10^{-5}	6×10^{-3}	4×10^{-7}	2×10^{-3}
Dysprosium (66)	Dy 165	S	3×10^{-6}	1×10^{-3}	9×10^{-8}	4×10^{-4}
		I	2×10^{-6}	1×10^{-3}	7×10^{-8}	4×10^{-4}
	Dy 166	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-4}
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-4}
Einsteinium (99)	Es 253	S	8×10^{-10}	7×10^{-4}	3×10^{-11}	2×10^{-4}
		I	6×10^{-10}	7×10^{-4}	2×10^{-11}	2×10^{-4}
	Es 254m	S	5×10^{-9}	5×10^{-4}	2×10^{-10}	2×10^{-4}
		I	6×10^{-9}	5×10^{-4}	2×10^{-10}	2×10^{-4}
	Es 254	S	2×10^{-11}	4×10^{-4}	6×10^{-13}	1×10^{-4}
		I	1×10^{-10}	4×10^{-4}	4×10^{-12}	1×10^{-4}
	Es 255	S	5×10^{-10}	8×10^{-4}	2×10^{-11}	3×10^{-4}
		I	4×10^{-10}	8×10^{-4}	1×10^{-11}	3×10^{-4}
Erbium (68)	Er 169	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-4}
		I	4×10^{-7}	3×10^{-3}	1×10^{-8}	9×10^{-4}
	Er 171	S	7×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Europium (63)	Eu 152 (T/2 = 9.2 hrs)	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-4}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-4}
	Eu 152 (T/2 = 13 yrs)	S	1×10^{-6}	2×10^{-3}	4×10^{-10}	8×10^{-4}
		I	2×10^{-6}	2×10^{-3}	6×10^{-10}	8×10^{-4}
	Eu 154	S	4×10^{-9}	6×10^{-4}	1×10^{-10}	2×10^{-4}
		I	7×10^{-9}	6×10^{-4}	2×10^{-10}	2×10^{-4}
	Eu 155	S	9×10^{-9}	6×10^{-3}	3×10^{-9}	2×10^{-4}
		I	7×10^{-9}	6×10^{-3}	3×10^{-9}	2×10^{-4}

APPENDIX B

Concentrations in Air and Water Above Natural Background—Continued

(See footnotes on page 20-15)

Element (atomic number)	Isotope [1]	†	Table I Column 1 Air (μCi/ml)	Table I Column 2 Water (μCi/ml)	Table II Column 1 Air (μCi/ml)	Table II Column 2 Water (μCi/ml)
Fermium (100)	Fm 254	S	6×10^{-6}	4×10^{-3}	2×10^{-7}	1×10^{-4}
		I	7×10^{-6}	4×10^{-3}	2×10^{-7}	1×10^{-4}
	Fm 255	S	2×10^{-6}	1×10^{-3}	6×10^{-10}	3×10^{-4}
		I	1×10^{-6}	1×10^{-3}	4×10^{-10}	3×10^{-4}
	Fm 256	S	3×10^{-6}	3×10^{-3}	1×10^{-10}	9×10^{-7}
		I	2×10^{-6}	3×10^{-3}	6×10^{-11}	9×10^{-7}
Fluorine (9)	F 18	S	5×10^{-6}	2×10^{-3}	2×10^{-7}	8×10^{-4}
		I	3×10^{-6}	1×10^{-3}	9×10^{-8}	5×10^{-4}
Gadolinium (64)	Gd 153	S	2×10^{-7}	6×10^{-3}	8×10^{-9}	2×10^{-4}
		I	9×10^{-6}	6×10^{-3}	3×10^{-7}	2×10^{-4}
	Gd 159	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	8×10^{-5}
		I	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}
Gallium (31)	Ga 72	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-4}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-4}
Germanium (32)	Ge 71	S	1×10^{-5}	5×10^{-2}	4×10^{-7}	2×10^{-3}
		I	6×10^{-6}	5×10^{-2}	2×10^{-7}	2×10^{-3}
Gold (79)	Au 196	S	1×10^{-6}	5×10^{-3}	4×10^{-8}	2×10^{-4}
		I	6×10^{-7}	4×10^{-3}	2×10^{-8}	1×10^{-4}
	Au 198	S	3×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	5×10^{-5}
	Au 199	S	1×10^{-6}	5×10^{-3}	4×10^{-8}	2×10^{-4}
		I	8×10^{-7}	4×10^{-3}	3×10^{-8}	2×10^{-4}
Hafnium (72)	Hf 181	S	4×10^{-6}	2×10^{-3}	1×10^{-7}	7×10^{-5}
		I	7×10^{-6}	2×10^{-3}	3×10^{-7}	7×10^{-5}
Holmium (67)	Ho 166	S	2×10^{-7}	9×10^{-4}	7×10^{-9}	3×10^{-4}
		I	2×10^{-7}	9×10^{-4}	6×10^{-9}	3×10^{-4}
Hydrogen (1)	H3	S	5×10^{-6}	1×10^{-1}	2×10^{-7}	3×10^{-3}
		I	5×10^{-6}	1×10^{-1}	2×10^{-7}	3×10^{-3}
		Sub	2×10^{-6}	.....	4×10^{-8}	.....
Indium (49)	In 113m	S	8×10^{-6}	4×10^{-3}	3×10^{-7}	1×10^{-4}
		I	7×10^{-6}	4×10^{-3}	2×10^{-7}	1×10^{-4}
	In 114m	S	1×10^{-7}	5×10^{-4}	4×10^{-9}	2×10^{-5}
		I	2×10^{-8}	5×10^{-4}	7×10^{-10}	2×10^{-5}
	In 115m	S	2×10^{-6}	1×10^{-2}	8×10^{-8}	4×10^{-4}
		I	2×10^{-6}	1×10^{-2}	6×10^{-8}	4×10^{-4}
	In 115	S	2×10^{-7}	3×10^{-3}	9×10^{-9}	9×10^{-5}
		I	3×10^{-8}	3×10^{-3}	1×10^{-9}	9×10^{-5}
Iodine (53)	I 125	S	5×10^{-9}	4×10^{-3}	8×10^{-11}	2×10^{-4}
		I	2×10^{-7}	6×10^{-3}	6×10^{-9}	2×10^{-4}
	I 126	S	8×10^{-9}	5×10^{-3}	9×10^{-11}	3×10^{-4}
		I	3×10^{-7}	3×10^{-3}	1×10^{-8}	9×10^{-5}
	I 129	S	2×10^{-9}	1×10^{-3}	2×10^{-11}	6×10^{-5}
		I	7×10^{-8}	6×10^{-3}	2×10^{-9}	2×10^{-4}
	I 131	S	9×10^{-9}	6×10^{-3}	1×10^{-10}	2×10^{-4}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
	I 132	S	2×10^{-7}	2×10^{-3}	3×10^{-9}	8×10^{-5}
		I	9×10^{-7}	3×10^{-3}	3×10^{-8}	2×10^{-4}
	I 133	S	3×10^{-8}	2×10^{-3}	4×10^{-10}	1×10^{-4}
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-5}
	I 134	S	3×10^{-7}	4×10^{-3}	6×10^{-9}	2×10^{-4}

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APPENDIX B

Concentrations in Air and Water Above Natural Background—Continued

(See footnotes on page 20-45)

Element (atomic number)	Isotope [1]	†	Table I Column 1 Air (μCi/ml)	Table I Column 2 Water (μCi/ml)	Table II Column 1 Air (μCi/ml)	Table II Column 2 Water (μCi/ml)
Iodine (53)	I 126	I	3×10^{-8}	2×10^{-6}	1×10^{-7}	6×10^{-6}
	I 129	S	1×10^{-7}	7×10^{-6}	1×10^{-9}	4×10^{-8}
		I	4×10^{-7}	2×10^{-5}	1×10^{-8}	7×10^{-8}
Iridium (77)	Ir 190	S	1×10^{-6}	6×10^{-5}	4×10^{-8}	2×10^{-6}
		I	4×10^{-7}	3×10^{-5}	1×10^{-8}	2×10^{-6}
	Ir 192	S	1×10^{-7}	1×10^{-5}	4×10^{-9}	4×10^{-8}
		I	3×10^{-8}	1×10^{-5}	9×10^{-10}	4×10^{-8}
	Ir 194	S	2×10^{-7}	1×10^{-5}	8×10^{-9}	3×10^{-8}
		I	2×10^{-7}	9×10^{-6}	5×10^{-9}	3×10^{-8}
Iron (26)	Fe 55	S	9×10^{-7}	2×10^{-5}	3×10^{-8}	8×10^{-8}
		I	1×10^{-6}	7×10^{-5}	3×10^{-8}	2×10^{-7}
	Fe 59	S	1×10^{-7}	2×10^{-5}	5×10^{-9}	6×10^{-8}
		I	8×10^{-8}	2×10^{-5}	2×10^{-9}	8×10^{-8}
Krypton (36)	Kr 85m	Sub	6×10^{-6}	.....	1×10^{-7}	.....
	Kr 85	Sub	1×10^{-5}	.....	3×10^{-7}	.....
	Kr 87	Sub	1×10^{-6}	.....	2×10^{-8}	.....
	Kr 88	Sub	1×10^{-6}	.....	2×10^{-8}	.....
Lanthanum (57)	La 140	S	2×10^{-7}	7×10^{-6}	5×10^{-9}	2×10^{-7}
		I	1×10^{-7}	7×10^{-6}	4×10^{-9}	2×10^{-7}
Lead (82)	Pb 203	S	3×10^{-6}	1×10^{-5}	9×10^{-8}	4×10^{-6}
		I	2×10^{-6}	1×10^{-5}	6×10^{-8}	4×10^{-6}
	Pb 210	S	1×10^{-10}	4×10^{-8}	4×10^{-12}	1×10^{-7}
		I	2×10^{-10}	8×10^{-8}	8×10^{-12}	2×10^{-6}
	Pb 212	S	2×10^{-8}	4×10^{-6}	6×10^{-10}	2×10^{-7}
		I	2×10^{-8}	5×10^{-6}	7×10^{-10}	2×10^{-7}
Lutetium (71)	Lu 177	S	6×10^{-7}	3×10^{-5}	2×10^{-8}	1×10^{-6}
		I	5×10^{-7}	3×10^{-5}	2×10^{-8}	1×10^{-6}
Manganese (25)	Mn 52	S	2×10^{-7}	1×10^{-5}	7×10^{-9}	3×10^{-7}
		I	1×10^{-7}	9×10^{-6}	5×10^{-9}	3×10^{-7}
	Mn 54	S	4×10^{-7}	4×10^{-5}	1×10^{-8}	1×10^{-6}
		I	4×10^{-7}	3×10^{-5}	1×10^{-8}	1×10^{-6}
	Mn 56	S	8×10^{-7}	4×10^{-5}	3×10^{-8}	1×10^{-6}
		I	5×10^{-7}	3×10^{-5}	2×10^{-8}	1×10^{-6}
Mercury (80)	Hg 197m	S	7×10^{-7}	6×10^{-5}	3×10^{-8}	2×10^{-6}
		I	8×10^{-7}	5×10^{-5}	3×10^{-8}	2×10^{-6}
	Hg 197	S	1×10^{-6}	9×10^{-5}	4×10^{-8}	3×10^{-6}
		I	3×10^{-6}	1×10^{-5}	9×10^{-8}	5×10^{-6}
	Hg 203	S	7×10^{-8}	5×10^{-6}	2×10^{-9}	2×10^{-7}
		I	1×10^{-7}	3×10^{-5}	4×10^{-9}	1×10^{-6}
Molybdenum (42)	Mo 99	S	7×10^{-7}	5×10^{-5}	3×10^{-8}	2×10^{-6}
		I	2×10^{-7}	1×10^{-5}	7×10^{-9}	4×10^{-7}
Neodymium (60)	Nd 144	S	8×10^{-11}	2×10^{-7}	3×10^{-12}	7×10^{-7}
		I	3×10^{-10}	2×10^{-7}	1×10^{-11}	8×10^{-7}
	Nd 147	S	4×10^{-7}	2×10^{-5}	1×10^{-8}	6×10^{-7}
		I	2×10^{-7}	2×10^{-5}	8×10^{-9}	6×10^{-7}
	Nd 149	S	2×10^{-6}	8×10^{-5}	6×10^{-8}	3×10^{-6}
		I	1×10^{-6}	8×10^{-5}	5×10^{-8}	3×10^{-6}

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Concentrations in Air and Water Above Natural Background—Continued

(See footnotes on page 20-45)

Element (atomic number)	Isotope [1]	†	Table I Column 1 Air (μCi/ml)	Table I Column 2 Water (μCi/ml)	Table II Column 1 Air (μCi/ml)	Table II Column 2 Water (μCi/ml)
Neptunium (93)	Np 237	S	4×10^{-12}	9×10^{-8}	1×10^{-11}	3×10^{-6}
		I	1×10^{-10}	9×10^{-6}	4×10^{-10}	3×10^{-6}
	Np 239	S	8×10^{-7}	4×10^{-5}	3×10^{-8}	1×10^{-6}
		I	7×10^{-7}	4×10^{-5}	2×10^{-8}	1×10^{-6}
Nickel (28)	Ni 59	S	5×10^{-7}	6×10^{-5}	2×10^{-8}	2×10^{-6}
		I	8×10^{-7}	6×10^{-5}	3×10^{-8}	2×10^{-6}
	Ni 63	S	6×10^{-6}	8×10^{-5}	2×10^{-7}	3×10^{-6}
		I	3×10^{-7}	2×10^{-5}	1×10^{-8}	7×10^{-7}
	Ni 65	S	9×10^{-7}	4×10^{-5}	3×10^{-8}	1×10^{-6}
		I	5×10^{-7}	3×10^{-5}	2×10^{-8}	1×10^{-6}
Niobium (Columbium) (41)	Nb 92m	S	1×10^{-7}	1×10^{-5}	4×10^{-9}	4×10^{-7}
		I	2×10^{-7}	1×10^{-5}	5×10^{-9}	4×10^{-7}
	Nb 93	S	5×10^{-7}	3×10^{-5}	2×10^{-8}	1×10^{-6}
		I	1×10^{-7}	3×10^{-5}	3×10^{-9}	1×10^{-6}
	Nb 97	S	6×10^{-6}	3×10^{-5}	2×10^{-7}	9×10^{-6}
		I	5×10^{-6}	3×10^{-5}	2×10^{-7}	9×10^{-6}
Osmium (76)	Os 185	S	5×10^{-7}	2×10^{-5}	2×10^{-8}	7×10^{-7}
		I	5×10^{-6}	2×10^{-5}	2×10^{-9}	7×10^{-7}
	Os 191m	S	2×10^{-5}	7×10^{-5}	6×10^{-7}	3×10^{-6}
		I	9×10^{-6}	7×10^{-5}	3×10^{-7}	2×10^{-6}
	Os 191	S	1×10^{-6}	5×10^{-5}	4×10^{-8}	2×10^{-6}
		I	4×10^{-7}	5×10^{-5}	1×10^{-8}	2×10^{-6}
	Os 193	S	4×10^{-7}	2×10^{-5}	1×10^{-8}	6×10^{-7}
		I	3×10^{-7}	2×10^{-5}	9×10^{-9}	5×10^{-7}
Palladium (46)	Pd 103	S	1×10^{-6}	1×10^{-5}	5×10^{-8}	3×10^{-6}
		I	7×10^{-7}	8×10^{-5}	3×10^{-8}	3×10^{-6}
	Pd 109	S	6×10^{-7}	3×10^{-5}	2×10^{-8}	9×10^{-7}
		I	4×10^{-7}	2×10^{-5}	1×10^{-8}	7×10^{-7}
Phosphorus (15)	P 32	S	7×10^{-8}	5×10^{-6}	2×10^{-9}	2×10^{-7}
		I	8×10^{-8}	7×10^{-6}	3×10^{-9}	2×10^{-7}
Platinum (78)	Pt 191	S	8×10^{-7}	4×10^{-5}	3×10^{-8}	1×10^{-6}
		I	6×10^{-7}	3×10^{-5}	2×10^{-8}	1×10^{-6}
	Pt 193m	S	7×10^{-6}	3×10^{-5}	2×10^{-7}	1×10^{-6}
		I	5×10^{-6}	3×10^{-5}	2×10^{-7}	1×10^{-6}
*	Pt 193	S	1×10^{-6}	3×10^{-5}	4×10^{-8}	9×10^{-7}
		I	3×10^{-7}	3×10^{-5}	1×10^{-8}	2×10^{-6}
	Pt 197m	S	6×10^{-7}	3×10^{-5}	2×10^{-7}	1×10^{-6}
		I	5×10^{-6}	3×10^{-5}	2×10^{-7}	9×10^{-7}
	Pt 197	S	8×10^{-7}	4×10^{-5}	3×10^{-8}	1×10^{-6}
		I	6×10^{-7}	3×10^{-5}	2×10^{-8}	1×10^{-6}
Plutonium (94)	Pu 238	S	2×10^{-12}	1×10^{-4}	7×10^{-14}	3×10^{-6}
		I	3×10^{-11}	8×10^{-4}	1×10^{-10}	3×10^{-5}
	Pu 239	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	3×10^{-6}
		I	4×10^{-11}	8×10^{-4}	1×10^{-12}	3×10^{-5}
	Pu 240	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	3×10^{-6}
		I	4×10^{-11}	8×10^{-4}	1×10^{-12}	3×10^{-5}
	Pu 241	S	9×10^{-11}	7×10^{-3}	3×10^{-12}	2×10^{-4}
		I	4×10^{-9}	4×10^{-3}	1×10^{-9}	1×10^{-3}

APPENDIX B

Concentrations in Air and Water Above Natural Background—Continued

(See footnotes on page 20-45)

Element (atomic number)	Isotope [1]	†	Table I Column 1 Air (μCi/ml)	Table I Column 2 Water (μCi/ml)	Table II Column 1 Air (μCi/ml)	Table II Column 2 Water (μCi/ml)
Plutonium (94)	Pu 242	S	2×10^{-12}	1×10^{-8}	6×10^{-14}	5×10^{-9}
		I	4×10^{-11}	9×10^{-8}	1×10^{-12}	3×10^{-8}
	Pu 243	S	2×10^{-8}	1×10^{-7}	6×10^{-9}	3×10^{-8}
		I	2×10^{-8}	1×10^{-7}	8×10^{-9}	3×10^{-8}
	Pu 244	S	2×10^{-12}	1×10^{-8}	6×10^{-14}	4×10^{-9}
		I	3×10^{-11}	2×10^{-8}	1×10^{-12}	1×10^{-8}
Polonium (84)	Po 210	S	5×10^{-10}	2×10^{-7}	2×10^{-11}	7×10^{-7}
		I	2×10^{-10}	8×10^{-8}	7×10^{-12}	3×10^{-7}
Potassium (19)	K 42	S	2×10^{-6}	9×10^{-5}	7×10^{-8}	3×10^{-6}
		I	1×10^{-7}	6×10^{-6}	4×10^{-9}	2×10^{-7}
Praseodymium (59)	Pr 142	S	2×10^{-7}	9×10^{-6}	7×10^{-9}	3×10^{-7}
		I	2×10^{-7}	9×10^{-6}	8×10^{-9}	3×10^{-7}
	Pr 143	S	3×10^{-7}	1×10^{-5}	1×10^{-8}	5×10^{-7}
		I	2×10^{-7}	1×10^{-5}	6×10^{-9}	5×10^{-7}
Promethium (61)	Pm 147	S	6×10^{-8}	6×10^{-6}	2×10^{-9}	2×10^{-7}
		I	1×10^{-7}	6×10^{-6}	3×10^{-9}	2×10^{-7}
	Pm 149	S	3×10^{-7}	1×10^{-5}	1×10^{-8}	4×10^{-7}
		I	2×10^{-7}	1×10^{-5}	8×10^{-9}	4×10^{-7}
Protactinium (91)	Pa 230	S	2×10^{-9}	7×10^{-7}	6×10^{-11}	2×10^{-7}
		I	8×10^{-10}	7×10^{-7}	3×10^{-11}	2×10^{-7}
	Pa 231	S	1×10^{-12}	3×10^{-3}	4×10^{-14}	9×10^{-7}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	2×10^{-3}
	Pa 233	S	6×10^{-7}	4×10^{-3}	2×10^{-8}	1×10^{-6}
		I	2×10^{-7}	3×10^{-3}	6×10^{-9}	1×10^{-6}
Radium (88)	Ra 223	S	2×10^{-9}	2×10^{-5}	6×10^{-11}	7×10^{-7}
		I	2×10^{-10}	1×10^{-6}	8×10^{-12}	4×10^{-8}
	Ra 224	S	5×10^{-9}	7×10^{-5}	2×10^{-10}	2×10^{-6}
		I	7×10^{-10}	2×10^{-6}	2×10^{-11}	5×10^{-8}
	Ra 226	S	2×10^{-11}	4×10^{-7}	3×10^{-12}	3×10^{-9}
		I	5×10^{-11}	9×10^{-6}	2×10^{-12}	3×10^{-8}
	Ra 228	S	7×10^{-11}	8×10^{-7}	2×10^{-12}	3×10^{-8}
		I	4×10^{-11}	7×10^{-6}	1×10^{-12}	3×10^{-8}
Radon (86)	Rn 220	S	3×10^{-7}		1×10^{-9}	
	Rn 222 [3] ***	S	3×10^{-8}		3×10^{-10}	
Rhenium (75)	Re 183	S	3×10^{-6}	2×10^{-3}	9×10^{-8}	6×10^{-6}
		I	2×10^{-7}	8×10^{-5}	5×10^{-9}	3×10^{-6}
	Re 186	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-6}
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	5×10^{-6}
	Re 187	S	9×10^{-6}	7×10^{-2}	3×10^{-7}	3×10^{-3}
		I	5×10^{-7}	4×10^{-2}	2×10^{-8}	2×10^{-3}
	Re 188	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
		I	2×10^{-7}	9×10^{-4}	6×10^{-9}	3×10^{-5}
Rhodium (45)	Rh 103m	S	8×10^{-5}	4×10^{-1}	3×10^{-6}	1×10^{-2}
		I	6×10^{-5}	3×10^{-1}	2×10^{-6}	1×10^{-2}
	Rh 105	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Rubidium (37)	Rb 86	S	3×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-5}
		I	7×10^{-8}	7×10^{-4}	2×10^{-9}	2×10^{-5}
	Rb 87	S	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	7×10^{-8}	5×10^{-3}	2×10^{-9}	2×10^{-4}

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NOTE: Amendments made by 40 FR 50704 become effective 1/28/76.

November 14, 1975

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Concentrations in Air and Water Above Natural Background—Continued

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Element (atomic number)	Isotope [1]	†	Table I Column 1 Air (μCi/ml)	Table I Column 2 Water (μCi/ml)	Table II Column 1 Air (μCi/ml)	Table II Column 2 Water (μCi/ml)
Ruthenium (44)	Ru 97	S	2×10^{-6}	1×10^{-4}	8×10^{-8}	4×10^{-6}
		I	2×10^{-6}	1×10^{-4}	6×10^{-8}	3×10^{-6}
	Ru 103	S	3×10^{-7}	2×10^{-3}	2×10^{-8}	8×10^{-6}
		I	8×10^{-8}	2×10^{-3}	3×10^{-9}	8×10^{-6}
	Ru 105	S	7×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-5}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-5}
	Ru 106	S	8×10^{-8}	4×10^{-4}	3×10^{-9}	1×10^{-6}
		I	6×10^{-8}	3×10^{-4}	2×10^{-10}	1×10^{-6}
Samarium (62)	Sm 147	S	7×10^{-11}	2×10^{-3}	2×10^{-12}	6×10^{-9}
		I	3×10^{-10}	2×10^{-3}	9×10^{-12}	7×10^{-9}
	Sm 151	S	6×10^{-6}	1×10^{-2}	2×10^{-7}	4×10^{-5}
		I	1×10^{-7}	1×10^{-2}	5×10^{-9}	4×10^{-5}
	Sm 153	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	8×10^{-6}
		I	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-6}
Scandium (21)	Sc 46	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-6}
		I	2×10^{-6}	1×10^{-3}	8×10^{-10}	4×10^{-6}
	Sc 47	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-6}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-6}
	Sc 48	S	2×10^{-7}	8×10^{-4}	6×10^{-9}	3×10^{-6}
		I	1×10^{-7}	8×10^{-4}	5×10^{-9}	3×10^{-6}
Selenium (34)	Se 75	S	1×10^{-6}	9×10^{-3}	4×10^{-8}	3×10^{-5}
		I	1×10^{-7}	8×10^{-3}	4×10^{-9}	3×10^{-5}
Silicon (14)	Si 31	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-6}
		I	1×10^{-6}	6×10^{-3}	3×10^{-8}	2×10^{-5}
Silver (47)	Ag 105	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-5}
		I	8×10^{-8}	3×10^{-3}	3×10^{-9}	1×10^{-5}
	Ag 110m	S	2×10^{-7}	9×10^{-4}	7×10^{-9}	3×10^{-6}
		I	1×10^{-7}	9×10^{-4}	3×10^{-10}	3×10^{-6}
	Ag 111	S	3×10^{-7}	1×10^{-3}	1×10^{-8}	4×10^{-6}
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-6}
Sodium (11)	Na 22	S	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-6}
		I	9×10^{-8}	9×10^{-4}	3×10^{-10}	3×10^{-6}
	Na 24	S	1×10^{-6}	6×10^{-3}	4×10^{-8}	2×10^{-5}
		I	1×10^{-7}	8×10^{-4}	5×10^{-9}	3×10^{-6}
Strontium (38)	Sr 83m	S	4×10^{-5}	2×10^{-1}	1×10^{-6}	7×10^{-4}
		I	3×10^{-5}	2×10^{-1}	1×10^{-6}	7×10^{-4}
	Sr 85	S	2×10^{-7}	3×10^{-3}	8×10^{-9}	1×10^{-4}
		I	1×10^{-7}	5×10^{-3}	4×10^{-9}	2×10^{-4}
	Sr 89	S	3×10^{-8}	3×10^{-4}	3×10^{-10}	3×10^{-6}
		I	4×10^{-8}	8×10^{-4}	1×10^{-9}	3×10^{-6}
	Sr 90	S	1×10^{-7}	1×10^{-3}	3×10^{-11}	3×10^{-7}
		I	5×10^{-9}	1×10^{-3}	2×10^{-10}	4×10^{-3}
	Sr 91	S	4×10^{-7}	2×10^{-3}	2×10^{-8}	7×10^{-5}
		I	3×10^{-7}	1×10^{-3}	9×10^{-9}	5×10^{-5}
	Sr 92	S	4×10^{-7}	2×10^{-3}	2×10^{-8}	7×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
Sulfur (16)	S 35	S	3×10^{-7}	2×10^{-3}	9×10^{-9}	6×10^{-5}
		I	3×10^{-7}	8×10^{-3}	9×10^{-9}	3×10^{-4}
Tantalum (73)	Ta 182	S	4×10^{-8}	1×10^{-3}	1×10^{-9}	4×10^{-5}
		I	2×10^{-8}	1×10^{-3}	7×10^{-10}	4×10^{-5}

NOTE: Amendments made by 40 FR 50704 become effective 1/28/76.

APPENDIX B

Concentrations in Air and Water Above Natural Background—Continued

(See footnotes on page 20-15)

Element (atomic number)	Isotope [1]	†	Table I Column 1 Air (μCi/ml)	Table I Column 2 Water (μCi/ml)	Table II Column 1 Air (μCi/ml)	Table II Column 2 Water (μCi/ml)
Technetium (43)	Tc 96m	S	8×10^{-5}	4×10^{-1}	3×10^{-6}	1×10^{-2}
		I	3×10^{-6}	3×10^{-1}	1×10^{-7}	1×10^{-2}
	Tc 96	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	5×10^{-5}
	Tc 97m	S	2×10^{-6}	1×10^{-2}	8×10^{-8}	4×10^{-4}
		I	2×10^{-7}	5×10^{-3}	5×10^{-9}	2×10^{-4}
	Tc 97	S	1×10^{-5}	5×10^{-2}	4×10^{-7}	2×10^{-3}
		I	3×10^{-7}	2×10^{-2}	1×10^{-8}	8×10^{-4}
	Tc 99m	S	4×10^{-4}	2×10^{-1}	1×10^{-5}	6×10^{-3}
		I	1×10^{-4}	8×10^{-2}	5×10^{-7}	3×10^{-3}
	Tc 99	S	2×10^{-6}	1×10^{-2}	7×10^{-8}	3×10^{-4}
		I	6×10^{-8}	5×10^{-3}	2×10^{-9}	2×10^{-4}
Tellurium (52)	Te 125m	S	4×10^{-7}	5×10^{-3}	1×10^{-8}	2×10^{-4}
		I	1×10^{-7}	3×10^{-3}	4×10^{-9}	1×10^{-4}
	Te 127m	S	1×10^{-7}	2×10^{-3}	5×10^{-9}	6×10^{-5}
		I	4×10^{-8}	2×10^{-3}	1×10^{-9}	5×10^{-5}
	Te 127	S	2×10^{-6}	8×10^{-3}	6×10^{-8}	3×10^{-4}
		I	9×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
	Te 129m	S	8×10^{-8}	1×10^{-3}	3×10^{-9}	3×10^{-5}
		I	3×10^{-8}	6×10^{-4}	1×10^{-9}	2×10^{-5}
	Te 129	S	5×10^{-6}	2×10^{-2}	2×10^{-7}	8×10^{-4}
		I	4×10^{-6}	2×10^{-2}	1×10^{-7}	8×10^{-4}
	Te 131m	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
	Te 132	S	2×10^{-7}	9×10^{-4}	7×10^{-9}	3×10^{-5}
		I	1×10^{-7}	6×10^{-4}	4×10^{-9}	2×10^{-5}
Terbium (65)	Tb 160	S	1×10^{-7}	1×10^{-3}	3×10^{-9}	4×10^{-5}
		I	3×10^{-8}	1×10^{-3}	1×10^{-9}	4×10^{-5}
Thallium (81)	Tl 200	S	3×10^{-6}	1×10^{-2}	9×10^{-8}	4×10^{-4}
		I	1×10^{-6}	7×10^{-3}	4×10^{-8}	2×10^{-4}
	Tl 201	S	2×10^{-6}	9×10^{-3}	7×10^{-8}	3×10^{-4}
		I	9×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
	Tl 202	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	2×10^{-7}	2×10^{-3}	8×10^{-9}	7×10^{-5}
	Tl 204	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	3×10^{-8}	2×10^{-3}	9×10^{-10}	6×10^{-5}
Thorium (90) *	Th 227	S	3×10^{-10}	5×10^{-4}	1×10^{-11}	2×10^{-5}
		I	2×10^{-10}	5×10^{-4}	6×10^{-12}	2×10^{-5}
	Th 228	S	9×10^{-12}	2×10^{-4}	3×10^{-13}	7×10^{-6}
		I	6×10^{-12}	4×10^{-4}	2×10^{-13}	1×10^{-5}
	Th 230	S	2×10^{-12}	5×10^{-5}	8×10^{-14}	2×10^{-6}
		I	1×10^{-11}	9×10^{-4}	3×10^{-13}	3×10^{-5}
*	Th 231	S	1×10^{-6}	7×10^{-3}	5×10^{-8}	2×10^{-4}
		I	1×10^{-6}	7×10^{-3}	4×10^{-8}	2×10^{-4}
	Th 232	S	3×10^{-11}	5×10^{-5}	1×10^{-12}	2×10^{-6}
		I	3×10^{-11}	1×10^{-3}	1×10^{-12}	4×10^{-5}
*‡	Th natural	S	6×10^{-11}	6×10^{-5}	2×10^{-12}	2×10^{-6}
		I	6×10^{-11}	6×10^{-4}	2×10^{-12}	2×10^{-5}

APPENDIX B

Concentrations in Air and Water Above Natural Background—Continued

(See footnotes on page 20-15)

Element (atomic number)	Isotope [1]	†	Table I Column 1 Air (μCi/ml)	Table I Column 2 Water (μCi/ml)	Table II Column 1 Air (μCi/ml)	Table II Column 2 Water (μCi/ml)
Thorium (90)	Th 234	S	6×10^{-8}	5×10^{-4}	2×10^{-9}	2×10^{-5}
		I	3×10^{-8}	5×10^{-4}	1×10^{-9}	2×10^{-5}
Thulium (69)	Tm 170	S	4×10^{-8}	1×10^{-3}	1×10^{-9}	5×10^{-5}
		I	3×10^{-8}	1×10^{-3}	1×10^{-9}	5×10^{-5}
	Tm 171	S	1×10^{-7}	1×10^{-2}	4×10^{-9}	5×10^{-4}
		I	2×10^{-7}	1×10^{-2}	8×10^{-9}	5×10^{-4}
Tin (50)	Sn 113	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	9×10^{-5}
		I	5×10^{-8}	2×10^{-3}	2×10^{-9}	8×10^{-5}
	Sn 125	S	1×10^{-7}	5×10^{-4}	4×10^{-9}	2×10^{-5}
		I	8×10^{-8}	5×10^{-4}	3×10^{-9}	2×10^{-5}
Tungsten (Wolfram) (74)	W 181	S	2×10^{-6}	1×10^{-2}	8×10^{-8}	4×10^{-4}
		I	1×10^{-7}	1×10^{-2}	4×10^{-9}	3×10^{-4}
	W 185	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	1×10^{-7}	3×10^{-3}	4×10^{-9}	1×10^{-4}
	W 187	S	4×10^{-7}	2×10^{-3}	2×10^{-8}	7×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
Uranium (92)	U 230	S	3×10^{-10}	1×10^{-4}	1×10^{-11}	5×10^{-6}
		I	1×10^{-10}	1×10^{-4}	4×10^{-12}	5×10^{-6}
	U 232	S	1×10^{-10}	8×10^{-4}	3×10^{-12}	3×10^{-5}
		I	3×10^{-11}	8×10^{-4}	9×10^{-13}	3×10^{-5}
	U 233	S	5×10^{-10}	9×10^{-4}	2×10^{-11}	3×10^{-5}
		I	1×10^{-10}	9×10^{-4}	4×10^{-12}	3×10^{-5}
**	U 234	S[4]	6×10^{-10}	9×10^{-4}	2×10^{-11}	3×10^{-5}
		I	1×10^{-10}	9×10^{-4}	4×10^{-12}	3×10^{-5}
**	U 235	S[4]	5×10^{-10}	8×10^{-4}	2×10^{-11}	3×10^{-5}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}
	U 236	S	6×10^{-10}	1×10^{-3}	2×10^{-11}	3×10^{-5}
		I	1×10^{-10}	1×10^{-3}	4×10^{-12}	3×10^{-5}
**	U 238	S[4]	7×10^{-11}	1×10^{-3}	3×10^{-12}	4×10^{-5}
		I	1×10^{-10}	1×10^{-3}	5×10^{-12}	4×10^{-5}
	U 240	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	3×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	3×10^{-5}
**	U-natural	S[4]	1×10^{-10}	1×10^{-3}	5×10^{-12}	3×10^{-5}
		I	1×10^{-10}	1×10^{-3}	5×10^{-12}	3×10^{-5}
Vanadium (23)	V 48	S	2×10^{-7}	9×10^{-4}	6×10^{-9}	3×10^{-5}
		I	6×10^{-8}	8×10^{-4}	2×10^{-9}	3×10^{-5}
Xenon (54)	Xe 131m	Sub	2×10^{-5}	....	4×10^{-7}	....
	Xe 133	Sub	1×10^{-5}	....	3×10^{-7}	....
	Xe 133m	Sub	1×10^{-5}	....	3×10^{-7}	....
	Xe 135	Sub	4×10^{-6}	....	1×10^{-7}	....
Ytterbium (70)	Yb 175	S	7×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Yttrium (39)	Y 90	S	1×10^{-7}	6×10^{-4}	4×10^{-9}	2×10^{-5}
		I	1×10^{-7}	6×10^{-4}	3×10^{-9}	2×10^{-5}
	Y 91m	S	2×10^{-5}	1×10^{-1}	8×10^{-7}	3×10^{-3}
		I	2×10^{-5}	1×10^{-1}	6×10^{-7}	3×10^{-3}
	Y 91	S	4×10^{-8}	8×10^{-4}	1×10^{-9}	3×10^{-5}
		I	3×10^{-8}	8×10^{-4}	1×10^{-9}	3×10^{-5}
	Y 92	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
	Y 93	S	2×10^{-7}	8×10^{-4}	6×10^{-9}	3×10^{-5}
		I	1×10^{-7}	8×10^{-4}	5×10^{-9}	3×10^{-5}

APPENDIX B

Concentrations in Air and Water Above Natural Background—Continued

(See footnotes on page 20-15)

Element (atomic number)	Isotope [1]		Table I Column 1 Air (μCi/ml)	Table I Column 2 Water (μCi/ml)	Table II Column 1 Air (μCi/ml)	Table II Column 2 Water (μCi/ml)
Zinc (30)	Zn 65	S	1×10^{-7}	3×10^{-3}	4×10^{-9}	1×10^{-4}
		I	6×10^{-8}	5×10^{-3}	2×10^{-9}	2×10^{-4}
	Zn 69m	S	4×10^{-7}	2×10^{-2}	1×10^{-8}	7×10^{-4}
		I	3×10^{-7}	2×10^{-2}	1×10^{-8}	6×10^{-4}
	Zn 69	S	7×10^{-6}	5×10^{-2}	2×10^{-7}	2×10^{-3}
		I	9×10^{-6}	5×10^{-2}	3×10^{-7}	2×10^{-3}
Zirconium (40)	Zr 93	S	1×10^{-7}	2×10^{-3}	4×10^{-9}	8×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}
	Zr 95	S	1×10^{-7}	2×10^{-3}	4×10^{-9}	6×10^{-5}
		I	3×10^{-8}	2×10^{-3}	1×10^{-9}	6×10^{-5}
	Zr 97	S	1×10^{-7}	5×10^{-4}	4×10^{-9}	2×10^{-5}
		I	9×10^{-8}	5×10^{-4}	3×10^{-9}	2×10^{-5}
Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life less than 2 hours.		Sub	1×10^{-6}	.....	3×10^{-8}	.....
Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life greater than 2 hours.			3×10^{-9}	9×10^{-5}	1×10^{-10}	3×10^{-6}
Any single radionuclide not listed above, which decays by alpha emission or spontaneous fission.			6×10^{-10}	4×10^{-7}	2×10^{-11}	3×10^{-9}

[1] Soluble (S); Insoluble (I).

[2] "Sub" means that values given are for submersion in a semispherical infinite cloud of airborne material.

[3] These radon concentrations are appropriate for protection from radon-222 combined with its short-lived daughters. Alternatively, the value in Table I may be replaced by one-third (⅓) "working level." (A "working level" is defined as any combination of short-lived radon-222 daughters, polonium-218, lead-214, bismuth-214 and polonium-214, in one liter of air, without regard to the degree of equilibrium, that will result in the ultimate emission of 1.3×10^5 MeV of alpha particle energy.) The Table II value may be replaced by one-thirtieth (1/30) of a "working level." The limit on radon-222 concentrations in restricted areas may be based on an annual average.

‡4. For soluble mixtures of U-238, U-234 and U-235 in air chemical toxicity may be the limiting factor. If the percent by weight (enrichment) of U-235 is less than 5, the concentration value for a 40-hour workweek, Table I, is 0.2 milligrams uranium per cubic meter of air average. For any enrichment, the product of the average concentration and time of exposure during a 40-hour workweek shall not exceed 8×10^{-9} SA μCi-hr/ml, where SA is the specific activity of the uranium inhaled. The concentration value for Table II is 0.007 milligrams uranium per cubic meter of air. The specific activity for natural uranium is 6.77×10^{-7} curies per gram U. The specific activity for other mixtures of U-238, U-235 and U-234, if not known, shall be:

$SA = 3.6 \times 10^{-7}$ curies/gram U (U-depleted E ≥ 0.72)

$SA = (0.4 + 0.38\,E + 0.0034\,E^2)\ 10^{-6}$

where E is the percentage by weight of U-235, expressed as percent.

*Amended 37 FR 23319.

**Amended 39 FR 23990; footnote redesignated 40 FR 50704.

***Amended 40 FR 50704.

†Amended 38 FR 29314.

‡Amended 39 FR 25463; redesignated 40 FR 50704.

39 FR 23990

40 FR 50704

[illegible] 82

NOTE: Amendments made by 40 FR 50704 become effective 1/28/76.

November 14, 1975

NOTE TO APPENDIX B

Note: In any case where there is a mixture in air or water of more than one radionuclide, the limiting values for purposes of this Appendix should be determined as follows:

1. If the identity and concentration of each radionuclide in the mixture are known, the limiting values should be derived as follows: Determine, for each radionuclide in the mixture, the ratio between the quantity present in the mixture and the limit otherwise established in Appendix B for the specific radionuclide when not in a mixture. The sum of such ratios for all the radionuclides in the mixture may not exceed "1" (i.e., "unity").

EXAMPLE: If radionuclides A, B, and C are present in concentrations C_A, C_B, and C_C, and if the applicable MPC's are MPC_A, and MPC_B, and MPC_C respectively, then the concentrations shall be limited so that the following relationship exists:

$$\frac{C_A}{MPC_A}+\frac{C_B}{MPC_B}+\frac{C_C}{MPC_C}\leq 1$$

2. If either the identity or the concentration of any radionuclide in the mixture is not known, the limiting values for purposes of Appendix B shall be:

a. For purposes of Table I, Col. 1—6×10^{-12}

b. For purposes of Table I, Col. 2—4×10^{-7}

c. For purposes of Table II, Col. 1—2×10^{-10}

d. For purposes of Table II, Col. 2—6×10^{-6}

3. If any of the conditions specified below are met, the corresponding values specified below may be used in lieu of those specified in paragraph 2 above.

a. If the identity of each radionuclide in the mixture is known but the concentration of one or more of the radionuclides in the mixture is not known, the concentration limit for the mixture is the limit specified in Appendix "B" for the radionuclide in the mixture having the lowest concentration limit; or

b. If the identity of each radionuclide in the mixture is not known, but it is known that certain radionuclides specified in Appendix "B" are not present in the mixture, the concentration limit for the mixture is the lowest concentration limit specified in Appendix "B" for any radionuclide which is not known to be absent from the mixture; or

Element (atomic number) and isotope	Table I		Table II	
	Column 1 Air (μCi/ml)	Column 2 Water (μCi/ml)	Column 1 Air (μCi/ml)	Column 2 Water (μCi/ml)
If it is known that Sr 90, I 125, I 126, I 129, I 131, Cf 253, table II only), Pb 210, Po 210, At 211, Ra 223, Ra 224, Ra 226, Ac 227, Ra 228, Th 230, Pa 231, Th 234, Th-nat, Cm 243, Cf 254, and Fm 253 are not present	.....	9×10^{-9}	.....	8×10^{-6}
If it is known that Sr 90, I 125, I 126, I 129, (I 131, I 133, table II only), Pb 210, Po 210, Ra 223, Ra 224, Ra 226, Ra 228, Pa 231, Th-nat, Cm 243, Cf 254, and Fm 255 are not present	.....	6×10^{-9}	.....	2×10^{-6}
If it is known that Sr 90, I 125, (I 125, I 126, I 129, I 131, table II only), Pb 210, Ra 224, Ra 226, Cm 243, and Cf 254 are not present	.....	3×10^{-9}	.....	6×10^{-7}
If it is known that (I 129, table II only), Ra 223, and Ra 228 are not present	.....	3×10^{-9}	.....	1×10^{-7}
If it is known that alpha-emitters and Sr 90, I 129, Pb 210, Ac 227, Ra 228, Pa 230, Pu 241, and Bk 249 are not present	3×10^{-9}	.....	1×10^{-10}	.....
If it is known that alpha-emitters and Pb 210, Ac 227, Ra 226, and Pu 241 are not present	3×10^{-10}	.....	1×10^{-11}	.....
If it is known that alpha-emitters and Ac 227 are not present	3×10^{-11}	.....	1×10^{-12}	.....
If it is known that Ac 227, Th 230, Pa 231, Pu 239, Pu 240, Pu 242, Pu 244, Cm 245, Cf 249 and Cf 251 are not present	3×10^{-12}	.....	1×10^{-13}	.....

4. If a mixture of radionuclides consists of uranium and its daughters in ore dust prior to chemical separation of the uranium from the ore, the values specified below may be used for uranium and its daughters through radium-226, instead of those from paragraphs 1, 2, or 3 above.

a. For purposes of Table I, Col. 1—1×10^{-10} μCi/ml gross alpha activity; or 8×10^{-11} μCi/ml natural uranium; or 75 micrograms per cubic meter of air natural uranium.

b. For purposes of Table II, Col. 1—8×10^{-12} μCi/ml gross alpha activity; or 3×10^{-11} μCi/ml natural uranium; or 3 micrograms per cubic meter of air natural uranium.

5. For purposes of this Note, a radionuclide may be considered as not present in a mixture if (a) the ratio of the concentration of that radionuclide in the mixture (C_A), to the concentration limit for that radionuclide specified in Table II of Appendix B (MPC_A) does not exceed 1/2 (i.e. $\frac{C_A}{MPC_A}\leq\frac{1}{2}$) and (b) the sum of such ratios for all the radionuclides considered as not present in the mixture does not exceed 1/2 (i.e. $\frac{C_A}{MPC_A}+\frac{C_B}{MPC_B}+\cdots\leq\frac{1}{2}$).

NOTE: Amendments made by 40 FR 50704 become effective 1/29/76.

Appendix C

Material	Microcuries
Americium-241	.01
Antimony-122	100
Antimony-124	10
Antimony-125	10
Arsenic-73	100
Arsenic-74	10
Arsenic-76	10
Arsenic-77	100
Barium-131	10
*Barium-133	10
Barium-140	10
Bismuth-210	1
Bromine-82	10
Cadmium-109	10
Cadmium-115m	10
Cadmium-115	100
Calcium-45	10
Calcium-47	10
Carbon-14	100
Cerium-141	100
Cerium-143	100
Cerium-144	1
Cesium-131	1,000
Cesium-134m	100
Cesium-134	1
Cesium-135	10
Cesium-136	10
Cesium-137	10
Chlorine-36	10
Chlorine-38	10
Chromium-51	1,000
Cobalt-58m	10
Cobalt-58	10
Cobalt-60	1
Copper-64	100
Dysprosium-165	10
Dysprosium-166	100
Erbium-169	100
Erbium-171	100
Europium-152 9.2 h	100
Europium-152 13 yr	1
Europium-154	1
Europium-155	10
Fluorine-18	1,000
Gadolinium-153	10
Gadolinium-159	100
Gallium-72	10
Germanium-71	100
Gold-198	100
Gold-199	100
Hafnium-181	10
Holmium-166	100
Hydrogen-3	1,000
Indium-113m	100
Indium-114m	10
Indium-115m	100
Indium-115	10
Iodine-125	1
Iodine-126	1
Iodine-129	0.1
Iodine-131	1
Iodine-132	10
Iodine-133	1
Iodine-134	10
Iodine-135	10
Iridium-192	10
Iridium-194	100
Iron-55	100
Iron-59	10
Krypton-85	100
Krypton-87	10
Lanthanum-140	10
Lutetium-177	100
Manganese-52	10
Manganese-54	10
Manganese-56	10
Mercury-197m	100
Mercury-197	100
Mercury-203	10
Molybdenum-99	100
Neodymium-147	100
Neodymium-149	100
Nickel-59	100
Nickel-63	10
Nickel-65	100
Niobium-93m	10
Niobium-95	10
Niobium-97	10
Osmium-185	10
Osmium-191m*	100
Osmium-191	100
Osmium-193	100
Palladium-103	100
Palladium-109	100
Phosphorus-32	10
Platinum-191	100
Platinum-193m	100
Platinum-193	100
Platinum-197m	100
Platinum-197	100
Plutonium-239	.01
Polonium-210	0.1
Potassium-42	10
Praseodymium-142	100
Praseodymium-143	100
Promethium-147	10
Promethium-149	10
Radium-226	.01
Rhenium-186	100
Rhenium-188	100
Rhodium-103m	100
Rhodium-105	100
Rubidium-86	10
Rubidium-87	10
Ruthenium-97	100
Ruthenium-103	10
Ruthenium-105	10
Ruthenium-106	1
Samarium-151	10
Samarium-153	100
Scandium-46	10
Scandium-47	100
Scandium-48	10
Selenium-75	10
Silicon-31	100
Silver-105	10
Silver-110m	1
Silver-111	100
Sodium-24	10
Strontium-85	10
Strontium-89	1
Strontium-90	0.1
Strontium-91	10
Strontium-92	10
Sulphur-35	100
Tantalum-182	10
Technetium-96	10
Technetium-97m	100
Technetium-97	100
Technetium-99m	100
Technetium-99	10
Tellurium-125m	10
Tellurium-127m	10
Tellurium-127	100
Tellurium-129m	10
Tellurium-129	100
Tellurium-131m	10
Tellurium-132	10
Terbium-160	10
Thallium-200	100
Thallium-201	100
Thallium-202	100
Thallium-204	10
**Thorium (natural)[1]	100
Thulium-170	10
Thulium-171	10
Tin-113	10
Tin-125	10
Tungsten-181	10
Tungsten-185	10
Tungsten-187	100
**Uranium (natural)[2]	100
Uranium-233	.01
Uranium-234-Uranium-238	.01
Vanadium-48	10
Xenon-131m	1,000
Xenon-133	100
Xenon-135	100
Ytterbium-175	100
Yttrium-90	10
Yttrium-91	10
Yttrium-92	100
Yttrium-93	100
Zinc-65	10
Zinc-69m	100
Zinc-69	1,000
Zirconium-93	10
Zirconium-95	10
Zirconium-97	10
Any alpha emitting radionuclide not listed above or mixtures of alpha emitters of unknown composition	.01
Any radionuclide other than alpha emitting radionuclides, not listed above or mixtures of beta emitters of unknown composition	.1

R 6425 — 35 FR 6425 — 35 FR 6425

Note: For purposes of §§ 20.303 and 20.304, where there is involved a combination of isotopes in known amounts the limit for the combination should be derived as follows: Determine, for each isotope in the combination, the ratio between the quantity present in the combination and the limit otherwise established for the specific isotope when not in combination. The sum of such ratios for all the isotopes in the combination may not exceed "1" (i.e., "unity"). Example: For purposes of § 20.304, if a particular batch contains 20,000 μCi† of Au^{198} and 50,000 μCi† of C^{14}, it may also include not more than 300 μCi† of I^{131}. This limit was determined as follows:

† $\frac{20{,}000\ \mu Ci\ Au^{198}}{100{,}000\ \mu Ci} + \frac{50{,}000\ \mu Ci\ C^{14}}{100{,}000\ \mu Ci} + \frac{300\ \mu Ci\ I^{131}}{1{,}000\ \mu Ci} = 1$

The denominator in each of the above ratios was obtained by multiplying the figure in the table by 1,000 as provided in § 20.304.

[1] Based on alpha disintegration rate of Th-232, Th-230 and their daughter products.

[2] Based on alpha disintegration rate of U-238, U-234, and U-235.

* Amended 36 FR 16898.

** Amended 36 FR 23990.

† Amended 38 FR 29314.

Appendix D

UNITED STATES NUCLEAR REGULATORY COMMISSION

INSPECTION AND ENFORCEMENT REGIONAL OFFICES

Region	Address	Telephone	
		Daytime	Nights and Holidays
I Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont	Region I, USNRC Office of Inspection and Enforcement 631 Park Avenue King of Prussia, Pa. 19406	(215) 337-1150	(215) 337-1150
II* Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, Panama Canal Zone, Puerto Rico, South Carolina, Tennessee, Virginia, Virgin Islands, and West Virginia	Region II, USNRC Office of Inspection and Enforcement 230 Peachtree St., N.W. Suite 818 Atlanta, Ga. 30303	(404) 526-4503	(404) 526-4503
III Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin	Region III, USNRC Office of Inspection and Enforcement 799 Roosevelt Road Glen Ellyn, Ill. 60137	(312) 858-2660	(312) 858-2660
IV* Arkansas, Colorado, Idaho, Kansas, Louisiana, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, Utah, and Wyoming	Region IV, USNRC Office of Inspection and Enforcement 611 Ryan Plaza Drive Suite 1000 Arlington, Texas 76012	(817) 334-2841	(817) 334-2841
V Alaska, Arizona, California, Hawaii, Nevada, Oregon, Washington, and U.S. territories and possessions in the Pacific	Region V, USNRC Office of Inspection and Enforcement 1990 N. California Blvd. Suite 202 Walnut Creek, Calif. 94596	(415) 486-3141	(415) 486-3141

40 FR 42557

NOTE: The reporting and record keeping requirements contained in §§ 20.205(b) and 20.205(c) and required by § 20.401(b) have been approved by GAO under B-180225 (R0054). The approval expires June 30, 1977.

PART 30

RULES OF GENERAL APPLICABILITY TO LICENSING OF BYPRODUCT MATERIAL

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30.71 Schedule B.

AUTHORITY: Secs. 81, 82, 161, 182, 183, 68 Stat. 935, 948, 953, 954, as amended (42 U.S.C. 2111, 2112, 2201, 2232, 2233); secs. 202, 206, 88 Stat. 1244, 1246 (42 U.S.C. 5842 and 5846)

Section 30.34(b) also issued under sec. 184, 68 Stat. 954, as amended (42 U.S.C. 2234). For the purposes of sec 223, 68 Stat. 958, as amended (42 U.S.C. 2273), § 30.34(c) issued under sec. 161b., 68 Stat. 948 (42 U.S.C. 2201 (b)) and §§ 30.51 and 30.52 issued under sec. 161, 68 Stat. 950, as amended (42 U.S.C. 2201(o))

30 FR 8185

§ 30.1 Purpose and scope.

40 FR 8774

This part prescribes rules applicable to all persons in the United States governing licensing of byproduct material under the Atomic Energy Act of 1954, as amended (68 Stat. 919), and under Title II of the Energy Reorganization Act of 1974 (88 Stat. 1242), and exemptions from the licensing requirements permitted by section 81 of the Act.

30 FR 8185

§ 30.2 Resolution of conflict.

The requirements of this part are in addition to, and not in substitution for, other requirements of this chapter. In any conflict between the requirements in this part and a specific requirement in another part of the regulations in this chapter, the specific requirement governs.

§ 30.3 Activities requiring license.

Except for persons exempt as provided in this part and Part 150 of this chapter, no person shall manufacture, produce, transfer, receive, acquire, own, possess, use, import or export byproduct material except as authorized in a specific or general license issued pursuant to the regulations in this chapter.

30 FR 8185

§ 30.4 Definitions.

As used in this part and Parts 31-36 of this chapter:

(a) "Act" means the Atomic Energy Act of 1954, (68 Stat. 919)* including any amendments thereto;

40 FR 8774

(a-1) "Administration" means the Energy Research and Development Administration or its duly authorized representatives;

30 FR 8185

(b) Terms defined in section 11 of the Act shall have the same meaning when used in the regulations in this part and Parts 31-36 to the extent such terms are not specifically defined in this part;

40 FR 8774

(c) "Agreement State" means any state with which the Atomic Energy Commission or the Nuclear Regulatory Commission has entered into an effective agreement under subsection 274b. of the Act. "Non-Agreement State" means any other State;

30 FR 8185

(d) "Byproduct material" means any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material;

(e) "Commission" means the Nuclear Regulatory Commission and its duly authorized representatives;

(f) "Curie" means that amount of radioactive material which disintegrates at the rate of 37 billion atoms per second;

(g) "Government agency" means any executive department, commission, independent establishment, corporation,

Amended 37 FR 9207.
‡ Added 37 FR 9207.

* Amended 39 FR 1466.

wholly or partly owned by the United States of America which is an instrumentality of the United States, or any board, bureau, division, service, office, officer, authority, administration, or other establishment in the executive branch of the Government;

(h) "Human use" means the internal or external administration of byproduct material, or the radiation therefrom, to human beings;

(i) "License" except where otherwise specified means a license for byproduct material issued pursuant to the regulations in this chapter;

(j)(1) "Microcurie" means that amount of radioactive material which disintegrates at the rate of 37 thousand atoms per second;

(2) "Millicurie" means that amount of radioactive material which disintegrates at the rate of 37 million atoms per second;

(k) "Person" means (1) any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency other than the Commission or the Administration, except that the Administration shall be considered a person within the meaning of the regulations this part to the extent that its facilities and activities are subject to the licensing and related regulatory authority of the Commission pursuant to section 202 of the Energy Reorganization Act of 1974 (88 Stat. 1244),[3] any State or any political subdivision of or any political entity within a State, any foreign government or nation or any political subdivision of any such government or nation, or other entity; and (2) any legal successor, representative, agent, or agency of the foregoing;

(l) "Physician" means an individual licensed by a State or territory of the United States, the District of Columbia or the Commonwealth of Puerto Rico to dispense drugs in the practice of medicine;

(m) "Production facility" means production facility as defined in the regulations contained in Part 50 of this chapter;

(n) "Radiographer" means any individual who performs or who, in attendance at the site where the sealed source or sources are being used, personally supervises radiographic operations and who is responsible to the licensee for assuring compliance with the requirements of the Commission's regulations and the conditions of the license;

(o) "Radiographer's assistant" means any individual who, under the personal supervision of a radiographer, uses radiographic exposure devices, sealed sources or related handling tools, or radiation* survey instruments in radiography;

(p) "Radiography" means the examination of the structure of materials by nondestructive methods, utilizing sealed sources of byproduct materials;

(q) "Research and development" means (1) theoretical analysis, exploration, or experimentation; or (2) the extension of investigative findings and theories of a scientific or technical nature into practical application for experimental and demonstration purposes, including the experimental production and testing of models, devices, equipment, materials and processes. "Research and development" as used in this part and Parts 31-36 does not include the internal or external administration of byproduct material, or the radiation therefrom, to human beings;

(r) "Sealed source" means any byproduct material that is encased in a capsule designed to prevent leakage or escape of the byproduct material;

(s) "Source material" means source material as defined in the regulations contained in Part 40 of this chapter;

(t) "Special nuclear material" means special nuclear material as defined in the regulations contained in Part 70 of this chapter;

(u) "United States", when used in a geographical sense, includes all territories and possessions of the United States, the Canal Zone and Puerto Rico;

(v) "Utilization facility" means a utilization facility as defined in the regulations contained in Part 50 of this chapter.

(w) "Commencement of construction" means any clearing of land, excavation, or other substantial action that would adversely affect the natural environment of a site but does not include changes desirable for the temporary use of the land for public recreational uses, necessary borings to determine site characteristics or other preconstruction monitoring to establish background information related to the suitability of a site or to the protection of environmental values.

§ 30.5 Interpretations.

Except as specifically authorized by the Commission in writing, no interpretation of the meaning of the regulations in this part and Parts 31-36 by any officer or employee of the Commission other than a written interpretation by the General Counsel will be recognized to be binding upon the Commission.

§ 30.6 Communications.

Except where otherwise specified, all communications and reports concerning the regulations in this part and Parts 31-36 and applications filed under them, should be addressed to the Director of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C., 20555. Communications, reports and applications may be delivered in person at the Commission's offices at 1717 H Street NW., Washington, D.C., or **7920 Norfolk Avenue, Bethesda, Md.

EXEMPTIONS

§ 30.11 Specific exemptions.[1]

(a) The Commission may, upon application of any interested person or upon its own initiative, grant such exemptions from the requirements of the regulations in this part and Parts 31-36 of this chapter as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest.

(b) Any person subject to the provisions of §§ 30.32(f) and 30.33(a)(5) may request an exemption from the requirements of those provisions. The Commis-

[3] The Administration facilities and activities identified in section 202 are:

(1) Demonstration Liquid Metal Fast Breeder reactors when operated as part of the power generation facilities of an electric utility system, or when operated in any other manner for the purpose of demonstrating the suitability for commercial application of such a reactor.

(2) Other demonstration nuclear reactors, except those in existence on January 19, 1975, when operated as part of the power generation facilities of an electric utility system, or when operated in any other manner for the purpose of demonstrating the suitability for commercial application of such a reactor.

(3) Facilities used primarily for the receipt and storage of high-level radioactive wastes resulting from licensed activities.

(4) Retrievable Surface Storage Facilities other facilities authorized for the express purpose of subsequent long-term storage of high-level radioactive waste generated by the Administration, which are not used for, or are part of, research and development activities.

* Amended 36 FR 1466.

[1] Issuance of an exemption by the Nuclear Regulatory Commission for export of byproduct material contained in materials or products does not relieve any person from complying with the licensing requirements and regulations of the Department of Commerce applicable to the export of the materials or the products containing such byproduct materials.

** Amended 34 FR 19546.

sion may grant an exemption from the provisions of § 30.32(f) and 30.33(a)(5) upon considering and balancing the following factors:

(1) Whether conduct of the proposed activities will give rise to a significant adverse impact on the environment and the nature and extent of such impact, if any;

(2) Whether redress of any adverse environmental impact from conduct of the proposed activities can reasonably be effected should such redress by necessary;

(3) Whether conduct of the proposed activities would foreclose subsequent adoption of alternatives; and

(4) The effect of delay in conducting such activities on public interest. During the period of any exemption granted pursuant to this paragraph (b), any activities conducted shall be carried out in such a manner as will minimize or reduce their environmental impact.

§ 30.12 Persons using byproduct material under certain Energy Research and Development Administration and Nuclear Regulatory Commission contracts.

40 FR 8774

Except to the extent that Administration facilities or activities of the types subject to licensing pursuant to section 2 of the Energy Reorganization Act of 74 are involved, any prime contractor of the Administration is exempt from the requirements for a license set forth in sections 81 and 82 of the Act and from the regulations in this part to the extent that such contractor, under his prime contract with the Administration manufactures, produces, transfers, receives, acquires, owns, possesses, uses, imports, or exports byproduct material for: (a) the performance of work for the Administration at a United States Government-owned or controlled site, including the transportation of by product material to or from such site and the performance of contract services during temporary interruptions of such transportation; (b) research in, or development, manufacture, storage, testing or transportation of, atomic weapons or components thereof; or (c) the use or operation of nuclear reactors or other nuclear devices in a United States Government-owned vehicle or vessel. In addition to the foregoing exemptions and subject to the requirement for licensing of Administration facilities and activities pursuant to section 202 of the Energy Reorganization Act of 1974, any prime contractor or subcontractor of the Administration or the Commission is exempt from the requirements for a license set forth in sections 81 and 82 of the Act and from the regulations in this part to the extent that such prime contractor or subcontractor manufactures, produces, transfers, receives, acquires, owns, possesses, uses, imports or exports byproduct material under his prime contract or subcontract when the Commission determines that the exemption of the prime contractor or subcontractor is authorized by law; and that, under the terms of the contract or subcontract, there is adequate assurance that the work thereunder can be accomplished without undue risk to the public health and safety.

40 FR 8774

§ 30.13 Carriers.

37 FR 3985

Common and contract carriers, freight forwarders, warehousemen, and the U.S. Postal Service are exempt from the regulations in this part and Parts 31-36 of this chapter and the requirements for a license set forth in section 81 of the Act to the extent that they transport or store byproduct material in the regular course of carriage for another or storage incident thereto.

§ 30.14 Exempt concentrations.

30 FR 8185

(a) Except as provided in paragraphs (c) and (d) of this section, any person is exempt from the requirements for a license set forth in section 81 of the Act and from the regulations in this part and Parts 31-36 of this chapter to the extent that such person receives, possesses, uses, transfers, owns or acquires products or materials containing byproduct material in concentrations not in excess of those listed in § 30.70.

(b) This section shall not be deemed to authorize the import of byproduct material or products containing byproduct material.

(c) A manufacturer, processor, or producer of a product or material in an Agreement State is exempt from the requirements for a license set forth in section 81 of the Act and from the regulations in this part and Parts 31, 32, 33, 34 and 36, to the extent that he transfers byproduct material contained in a product or material in concentrations not in excess of those specified in § 30.70 and introduced into the product or material by a licensee holding a specific license issued by an Agreement State, the Commission, or the Atomic Energy Commission expressly authorizing such introduction. This exemption does not apply to the transfer of byproduct material contained in any food, beverage, cosmetic, drug, or other commodity or product designed for ingestion or inhalation by or application to, a human being.

30 FR 8185

(d) No person may introduce byproduct material into a product or material knowing or having reason to believe that it will be transferred to persons exempt under this section or equivalent regulations of an Agreement State, except in accordance with a license issued prusuant to § 32.11 of this chapter or the general license provided in § 150.20 of Part 150.

34 FR 19546

§ 30.15 Certain items containing byproduct material.

34 FR 6651

(a) Except for persons who apply byproduct material to, or persons who incorporate byproduct material into, the following products, or persons who import for sale or distribution the following products containing byproduct material, any person is exempt from the requirements for a license set forth in section 81 of the Act and from the regulations in Parts 20 and 30-36 of this chapter to the extent that such person receives, possesses, uses, transfers, exports, owns, or acquires the following products:

32 FR 13920

(1) Timepieces or hands or dials containing not more than the following specified quantities of byproduct material and not exceeding the following specified levels of radiation:

(i) 25 millicuries of tritium per timepiece.

(ii) 5 millicuries of tritium per hand,

(iii) 15 millicuries of tritium per dial (bezels when used shall be considered as part of the dial),

(iv) 100 microcuries of promethium-147 per watch or 200 microcuries of promethium-147 per any other timepiece,

(v) 20 microcuries of promethium-147 per watch hand or 40 microcuries of promethium-147 per other timepiece hand,

(vi) 60 microcuries of promethium-147 per watch dial or 120 microcuries of promethium-147 per other timepiece dial (bezels when used shall be considered as part of the dial),

(vii) The levels of radiation from hands and dials containing promethium-147 will not exceed, when measured through 50 milligrams per square centimeter of absorber:

(a) For wrist watches, 0.1 millirad per hour at 10 centimeters from any surface,

(b) For pocket watches, 0.1 millirad per hour at 1 centimeter from any surface,

(c) For any other timepiece, 0.2

millirad per hour at 10 centimeters from any surface.

(2) Lock illuminators containing not more than 15 millicuries of tritium or not more than 2 millicuries of promethium-147 installed in automobile locks. The levels of radiation from each lock illuminator containing promethium-147 will not exceed 1 millirad per hour at 1 centimeter from any surface when measured through 50 milligrams per square centimeter of absorber. (31 FR 5315)

(3) Balances of precision containing not more than 1 millicurie of tritium per balance or not more than 0.5 millicurie of tritium per balance part.

(4) Automobile shift quadrants containing not more than 25 millicuries of tritium.

(5) Marine compasses containing not more than 750 millicuries of tritium gas and other marine navigational instruments containing not more than 250 millicuries of tritium gas. (32 FR 785)

(6) Thermostat dials and pointers containing not more than 25 millicuries of tritium per thermostat. (31 FR 5315)

(7) **

(8) Electron tubes; *Provided*. That each tube does not contain more than one of the following specified quantities of byproduct material: (35 FR 6820)

(i) 150 millicuries of tritium per microwave receiver protector tube or 10 millicuries of tritium per any other electron tube;

(ii) 1 microcurie of cobalt-60;
(iii) 5 microcuries of nickel-63;
(iv) 30 microcuries of krypton-85;
(v) 5 microcuries of cesium-137;
(vi) 30 microcuries of promethium-147;

And provided further. That the levels of radiation from each electron tube containing byproduct material do not exceed 1 millirad per hour at 1 centimeter from any surface when measured through 7 milligrams per square centimeter of absorber.[3] (34 FR 6651)

(9) Ionizing radiation measuring instruments containing, for purposes of internal calibration or standardization, a source of byproduct material not exceeding the applicable quantity set forth in § 30.71, Schedule B. (35 FR 6426)

(b) Any person who desires to apply byproduct material to, or to incorporate byproduct material into, the products exempted in paragraph (a) of this section, or who desires to import for sale or distribution such products containing byproduct material, should apply for a specific license pursuant to § 32.14 of this chapter, which license states that the product may be distributed by the licensee to persons exempt from the regulations pursuant to paragraph (a) of this section.

§ 30.16 Resins containing scandium-46 and designed for sand-consolidation in oil wells.

Any person is exempt from the requirements for a license set forth in section 81 of the Act and from the regulations in Parts 20 and 30-36 of this chapter to the extent that such person receives, possesses, uses, transfers, exports, owns, or acquires synthetic plastic resins containing scandium-46 which are designed for sand-consolidation in oil wells, and which have been manufactured or imported for sale or distribution, in accordance with a specific license issued pursuant to § 32.17 of this chapter or equivalent regulations of an Agreement State. The exemption in this section does not authorize the manufacture or import of any resins containing scandium-46. (32 FR 4241)

§ 30.18 Exempt quantities.

(a) Except as provided in paragraphs (c) and (d) of this section, any person is exempt from the requirements for a license set forth in section 81 of the Act and from the regulations in Parts 30-34 of this chapter to the extent that such person receives, possesses, uses, transfers, owns, or acquires byproduct material in individual quantities each of which does not exceed the applicable quantity set forth in § 30.71, Schedule B. (36 FR 16898)

(b) Any person who possesses byproduct material received or acquired prior to September 25, 1971, under the general license then provided in § 31.4 of this chapter is exempt from the requirements for a license set forth in section 81 of the Act and from the regulations in Parts 30-34 of this chapter to the extent that such person possesses, uses, transfers, or owns such byproduct material.

(c) This section does not authorize the production, packaging, repackaging, or import of byproduct material for purposes of commercial distribution, or the incorporation of byproduct material into products intended for commercial distribution.

(d) No person may, for purposes of commercial distribution, import or transfer byproduct material in the individual quantities set forth in § 30.71 Schedule B, knowing or having reason to believe that such quantities of byproduct material will be transferred to persons exempt under this section or equivalent regulations of an Agreement State, except in accordance with a license issued under § 32.18 of this chapter, which license states that the byproduct material may be transferred by the licensee to persons exempt under this section or the equivalent regulations of an Agreement State.

§ 30.19 Self-luminous products containing tritium, krypton-85, or promethium-147.

(a) Except for persons who manufacture, process, or produce self-luminous products containing tritium, krypton-85, or promethium-147, or who import such products, and except as provided in paragraph (c) of this section, any person is exempt from the requirements for a license set forth in section 81 of the Act and from the regulations in Parts 20 and 30-36 of this chapter to the extent that such person receives, possesses, uses, transfers, exports, owns, or acquires tritium, krypton-85, or promethium-147 in self-luminous products manufactured, processed, produced, imported, or transferred in accordance with a specific license issued pursuant to § 32.22 of this chapter, which license authorizes the transfer of the product for use under this section. (34 FR 9025)

(b) Any person who desires to manufacture, process, or produce self-luminous products containing tritium, krypton-85, or promethium-147, or to transfer or to import such products for use pursuant to paragraph (a) of this section, should apply for a license pursuant to § 32.22 of this chapter, which license states that the product may be transferred by the licensee to persons exempt from the regulations pursuant to paragraph (a) of this section or equivalent regulations of an Agreement State.

(c) The exemption in paragraph (a) of this section does not apply to tritium, krypton-85, or promethium-147 used in products primarily for frivolous purposes or in toys or adornments.

§ 30.20 Gas and aerosol detectors containing byproduct material.

[3] For purposes of this subparagraph "electron tubes" include spark gap tubes, power tubes, gas tubes including glow lamps, receiving tubes, microwave tubes, indicator tubes, pickup tubes, radiation detection tubes, and any other completely sealed tube that is designed to conduct or control electrical currents.

**Deleted 34 FR 6651.

34 FR 8853

(a) Except for persons who manufacture, process, or produce gas and aerosol detectors containing byproduct material who import such products, any person exempt from the requirements for a license set forth in section 81 of the Act and from the regulations in Parts 20 and 30-36 of this chapter to the extent that such person receives, possesses, uses, transfers, exports, owns, or acquires byproduct material in gas and aerosol detectors designed to protect life or property from fires and airborne hazards, and manufactured, processed, produced, imported, or transferred in accordance with a specific license issued pursuant to § 32.26 of this chapter, which license authorizes the transfer of the product for use under this section.

(b) Any person who desires to manufacture, process, or produce gas and aerosol detectors containing byproduct material, or to import or to transfer such products for use pursuant to paragraph (a) of this section, should apply for a license pursuant to § 32.26 of this chapter, which license states that the product may be transferred by the licensee to persons exempt from the regulations pursuant to paragraph (a) of this section or equivalent regulations of an Agreement State.

LICENSES

30.31 Types of licenses.

30 FR 8185

Licenses for byproduct material are of two types: General and specific. Specific licenses are issued to named persons upon applications filed pursuant to the regulations in this part and Parts 32-36. General licenses are effective without the filing of applications with the Commission or the issuance of licensing documents to particular persons.

40 FR 50703

§ 30.32 Application for specific licenses.

(a) Applications for specific licenses should be filed in duplicate on Form NRC-313, "Application for Byproduct Material License," with the Director of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

40 FR 8774

Applications may be filed in person at the Commission's offices at 1717 H Street, N.W., Washington, D.C., or 7920 Norfolk Avenue, Bethesda, Maryland. Information contained in previous applications, statements, or reports filed with the Commission or the Atomic Energy Commission may be incorporated by reference, provided that such references are clear and specific.

30 FR 8185

(b) The Commission may at any time after the filing of the original application, and before the expiration of the license, require further statements in order to enable the Commission to determine whether the application should be granted or denied or whether a license should be modified or revoked.

(c) Each application shall be signed by the applicant or licensee or a person duly authorized to act for and on his behalf.

(d) An application for license filed pursuant to the regulations in this part and Parts 32-36 will be considered also as an application for licenses authorizing other activities for which licenses are required by the Act, provided that the application specifies the additional activities for which licenses are requested and complies with regulations of the Commission as to applications for such licenses.

38 FR 145

(e) Each application for a byproduct material license, other than a license exempted from Part 170 of this chapter, shall be accompanied by the fee prescribed in § 170.31 of this chapter. No fee will be required to accompany an application for renewal or amendment of a license, except as provided in § 170.31 of this chapter.

37 FR 5745

(f) An application for a license to receive and possess byproduct material for commercial waste disposal by land burial or for the conduct of any other activity which the Commission determines will significantly affect the quality of the environment shall be filed at least 9 months prior to commencement of construction of the plant or facility in which the activity will be conducted and shall be accompanied by any Environmental Report required pursuant to Part 51** of this chapter.

§ 30.33 General requirements for issuance of specific licenses.

30 FR 8185

(a) An application for a specific license will be approved if:

(1) The application is for a purpose authorized by the Act;

(2) The applicant's proposed equipment and facilities are adequate to protect health and minimize danger to life or property.

(3) The applicant is qualified by training and experience to use the material for the purpose requested in such manner as to protect health and minimize danger to life or property;

(4) The applicant satisfies any special requirements contained in Parts 32-36; and

37 FR 5745

(5) In the case of an application for a license to receive and possess byproduct material for commercial waste disposal by land burial or for the conduct of any other activity which the Commission determines will significantly affect the quality of the environment, the Director of Nuclear Material Safety and Safeguards or his designee, before commencement of construction of the plan or facility in which the activity will be conducted, on the basis of information filed and evaluations made pursuant to Part 51** of this chapter, has concluded, after weighing the environmental, economic, technical, and other benefits against environmental costs and considering available alternatives, that the action called for is the issuance of the proposed license, with any appropriate conditions to protect environmental values. Commencement of construction prior to such conclusion may be grounds for denial of a license to receive and possess byproduct material in such plant or facility.

(b) Upon a determination that an application meets the requirements of the Act, and the regulations of the Commission, the Commission will issue a specific license authorizing the possession and use of byproduct material (Form NRC-374, "Byproduct Material License").

§ 30.34 Terms and conditions of licenses.

30 FR 8185

(a) Each license issued pursuant to the regulations in this part and the regulations in Parts 31-36 shall be subject to all the provisions of the Act, now or hereafter in effect, and to all valid rules, regulations and orders of the Commission.

(b) No license issued or granted pursuant to the regulations in this part and Parts 31-36, nor any right under a license shall be transferred, assigned or in any manner disposed of, either voluntarily or involuntarily, directly or indirectly, through transfer of control of any license to any person, unless the Commission shall, after securing full information, find that the transfer is in accordance with the provisions of the Act and shall give its consent in writing.

38 FR 33968

(c) Each person licensed by the Commission pursuant to the regulations in this part and Parts 31-36 shall confine his possession and use of the byproduct material to the locations and purposes authorized in the license. Except as otherwise provided in the license, a

**Amended 39 FR 2b279.

38 FR 33968

license issued pursuant to the regulations in this part and Parts 31-36 of this chapter shall carry with it the right to receive, acquire, own, possess, and import byproduct material. Preparation for shipment and transport of byproduct material shall be in accordance with the provisions of Part 71 of this chapter.

30 FR 8185

(d) Each license issued pursuant to the regulations in this part and Parts 31-36 shall be deemed to contain the provisions set forth in section 183b.-d., inclusive, of the Act, whether or not these provisions are expressly set forth in the license.

(e) The Commission may incorporate, in any license issued pursuant to the regulations in this part and Parts 31-36, at the time of issuance, or thereafter by appropriate rule, regulation or order, such additional requirements and conditions with respect to the licensee's receipt, possession, use and transfer of byproduct material as it deems appropriate or necessary in order to:

(1) Promote the common defense and security;

(2) Protect health or to minimize danger to life or property;

(3) Protect restricted data;

(4) Require such reports and the keeping of such records, and to provide for such inspections of activities under the license as may be necessary or appropriate to effectuate the purposes of the Act and regulations thereunder.

§ 30.35 [Deleted 40 FR 8774.]

§ 30.36 Expiration of licenses.

Except as provided in § 30.37(b), each specific license shall expire at the end of the day, in the month and year stated therein.

§ 30.37 Applications for renewal of licenses.

30 FR 8185

(a) Applications for renewal of a specific license shall be filed in accordance with § 30.32.

(b) In any case in which a licensee, not less than thirty (30) days prior to the expiration of his existing license, has filed an application in proper form for renewal or for a new license, such existing license shall not expire until the application has been finally determined by the Commission.

§ 30.38 Applications for amendment of licenses.

Applications for amendment of a license shall be filed in accordance with § 30.32 and shall specify the respects in which the licensee desires his license to be amended and the grounds for such amendment.

30 FR 8185

§ 30.39 Commission action on applications to renew or amend.

In considering an application by a licensee to renew or amend his license the Commission will apply the applicable criteria set forth in § 30.33 and Parts 32-36 of this chapter.

§ 30.41 Transfer of byproduct material.

38 FR 33968

(a) No licensee shall transfer byproduct material except as authorized pursuant to this section.

(b) Except as otherwise provided in his license and subject to the provisions of paragraphs (c) and (d) of this section, any licensee may transfer byproduct material:

(1) To the Administration;

40 FR 8774

(2) To the agency in any Agreement State which regulates radioactive material pursuant to an agreement under section 274 of the Act;

(3) To any person exempt from the licensing requirements of the Act and regulations in this part, to the extent permitted under such exemption;

(4) To any person in an Agreement State, subject to the jurisdiction of that State, who has been exempted from the licensing requirements and regulations of that State, to the extent permitted under such exemption;

(5) To any person authorized to receive such byproduct material under terms of a specific license or a general license or their equivalents issued by the Atomic Energy Commission, the Commission, or an Agreement State; or

38 FR 33968

(6) As otherwise authorized by the Commission in writing.

(c) Before transferring byproduct material to a specific licensee of the Commission or an Agreement State or to a general licensee who is required to register with the Commission or with an Agreement State prior to receipt of the byproduct material, the licensee transferring the material shall verify that the transferee's license authorizes the receipt of the type, form, and quantity of byproduct material to be transferred.

(d) The following methods for the verification required by paragraph (c) of this section are acceptable:

(1) The transferor may have in his possession, and read, a current copy of the transferee's specific license or registration certificate;

(2) The transferor may have in his possession a written certification by the transferee that he is authorized by license or registration certificate to receive the type, form, and quantity of byproduct material to be transferred, specifying the license or registration certificate number, issuing agency and expiration date;

(3) For emergency shipments the transferor may accept oral certification by the transferee that he is authorized by license or registration certificate to receive the type, form, and quantity of byproduct material to be transferred, specifying the license or registration certificate number, issuing agency and expiration date: *Provided*, That the oral certification is confirmed in writing within 10 days;

38 FR 33968

(4) The transferor may obtain other sources of information compiled by a reporting service from official records of the Commission or the licensing agency of an Agreement State as to the identity of licensees and the scope and expiration dates of licenses and registration; or

(5) When none of the methods of verification described in paragraphs (d)(1) to (4) of this section are readily available or when a transferor desires to verify that information received by one of such methods is correct or up-to-date, the transferor may obtain and record confirmation from the Commission or the licensing agency of an Agreement State that the transferee is licensed to receive the byproduct material.

RECORDS, INSPECTIONS, TESTS, PROCEDURES, AND REPORTS†

§ 30.51 Records.

30 FR 8185

Each person who receives byproduct material pursuant to a license issued pursuant to the regulations in this part and Parts 31-36 shall keep records showing the receipt, transfer, export and disposal of such byproduct material.

§ 30.52 Inspections.

(a) Each licensee shall afford to the Commission at all reasonable times opportunity to inspect byproduct material and the premises and facilities wherein byproduct material is used or stored.

(b) Each licensee shall make available to the Commission for inspection, upon reasonable notice, records kept by him pursuant to the regulations in this chapter.

§ 30.53 Tests.

† Amended 37 FR 9207.

Each licensee shall perform, or permit the Commission to perform, such tests as the Commission deems appropriate or necessary for the administration of the regulations in this part and Parts 31-36, including tests of:

(a) Byproduct material;

(b) Facilities wherein byproduct material is utilized or stored;

(c) Radiation detection and monitoring instruments; and

(d) Other equipment and devices used in connection with the utilization or storage of byproduct material.

30 FR 8185

§ 30.54 Control and accounting procedures for tritium.

(a) Except as specified in paragraph (b) of this section, each licensee who is authorized to possess at any one time and location more than 10,000 curies of tritium shall establish and maintain written material control and accounting procedures that are sufficient to enable the licensee to account for the tritium in his possession under specific license.

(b) Written material control and accounting procedures are not required for (1) tritium produced or possessed within a production or utilization facility incidental to the operation of the facility; (2) tritium contained in spent fuel, other than tritium intentionally produced in or recovered from a production or utilization facility for any subsequent use; (3) tritium contained in devices imported by persons licensed to transfer such devices to persons exempt from licensing pursuant to § 30.15; and (4) tritium contained in self-luminous devices imported by persons licensed to transfer such devices to persons exempt from licensing pursuant to § 30.19.

37 FR 9207

§ 30.55 Tritium reports.

(a) Except as specified in paragraph (d) of this section, each licensee who transfers or receives at any one time 1,000 curies or more of tritium shall complete and distribute a Nuclear Material Transaction* Report on Form NRC-741, in accordance with the printed instructions for completing the form. Each licensee who transfers such material shall submit a completed copy of Form NRC-741 to the Commission and three copies to the receiver of the material promptly after the transfer takes place. Each licensee who receives such material shall submit a completed copy of Form NRC-741 to the Commission and to the shipper of the material within ten (10) days after the material is received. The Commission's copies of the report shall be submitted to the U.S. Energy Research and Development Administration, Post Office Box E, Oak Ridge, Tennessee 37830, and shall include the Reporting Identification Symbol (RIS) assigned by the Commission to the licensee.

37 FR 9207

40 FR 8774

(b) Except as specified in paragraph (d) and (e) of this section, each licensee who is authorized to possess at any one time and location more than 10,000 curies of tritium shall submit to the Commission within thirty (30) days after June 30 and December 31 of each year a statement of his tritium inventory to the nearest hundredth of a gram calculated at 10,000 curies per gram.

The reports shall be submitted to the U.S. Energy Research and Development Administration, Post Office Box E, Oak Ridge, Tennessee 37830, and shall include the Reporting Identification Symbol (RIS) assigned by the Commission to the licensee.

37 FR 9207

41 FR 16465

30 FR 8185

(c) Except as specified in paragraph (d) of this section, each licensee who is authorized to possess, import, or export tritium shall report promptly to the appropriate NRC Regional Office listed in Appendix D of Part 20 of this chapter by telephone and telegraph, mailgram, or facsimile any incident in which an attempt has been made or is believed to have been made to commit a theft or unlawful diversion of more than 10 curies of such material at any one time or more than 100 curies of such material in any one calendar year. The initial report shall be followed within a period of fifteen (15) days by a written report submitted to the appropriate NRC Regional Office which sets forth the details of the incident and its consequences. Copies of such written report shall be sent to the Director of Inspection and Enforcement, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

Subsequent to the submission of the written report required by this paragraph, the licensee shall promptly inform the Office of Inspection and Enforcement by means of a written report of any substantive additional information, which becomes available to the licensee, concerning an attempted or apparent theft or unlawful diversion of tritium.

37 FR 9207

(d) The reports described in this section are not required for tritium possessed pursuant to a general license provided in Part 31 of this chapter or for tritium contained in spent fuel.

(e) The reports described in paragraph (b) of this section are not required for (1) tritium produced or possessed within a production or utilization facility incidental to the operation of the facility, other than tritium intentionally produced by or recovered from a production or utilization facility for any subsequent use; (2) tritium contained in devices imported by persons licensed to transfer such devices to persons exempt from licensing pursuant to § 30.15; or (3) tritium contained in self-luminous devices imported by persons licensed to transfer such devices to persons exempt from licensing pursuant to § 30.19.

37 FR 9207

ENFORCEMENT

§ 30.61 Modification and revocation of licenses.

(a) The terms and conditions of each license issued pursuant to the regualtions in this part and Parts 31-36 shall be subject to amendment, revision or modification by reason of amendments to the Act, or by reason of rules, regulations and orders issued in accordance with the terms of the Act.

(b) Any license may be revoked, suspended or modified, in whole or in part, for any material false statement in the application or any statement of fact required under section 182 of the Act, or because of conditions revealed by such application or statement of fact or any report, record or inspection or other means which would warrant the Commission to refuse to grant a license on an original application, or for violation of, or failure to observe any of the terms and provisions of the Act or of any rule, regulation or order of the Commission.

(c) Except in cases of willfulness or those in which the public health, interest or safety requires otherwise, no license shall be modified, suspended or revoked unless, prior to the institution of proceedings therefor, facts or conduct which may warrant such action shall have been called to the attention of the licensee in writing and the licensee shall have been accorded an opportunity to demonstrate or achieve compliance with all lawful requirements.

40 FR 8774

§ 30.62 Right to cause the withholding or recall of byproduct materials.

The Commission may cause the withholding or recall of byproduct material from any licensee who is not equipped to observe or fails to observe such safety standards to protect health as may be established by the Commission, or who uses such materials in violation of law or regulation of the Commission, or in a manner other than as disclosed in the application therefor or approved by the Commission.

30 FR 8185

40 FR 8774

§ 30.63 Violations.

An injunction or other court order may be obtained prohibiting any violation of any provision of the Atomic Energy Act of 1954, as amended, or Title II of the Energy Reorganization Act

* Amended 38 FR 2330.

of 1974, or any regulation or order issued thereunder. A court order may be obtained for the payment of a civil penalty imposed pursuant to section 234 of the Act for violation of section 53, 57, 62, 63, 81, 82, 101, 103, 104, 107, or 109 of the Act, or section 206 of the Energy Reorganization Act of 1974, or any rule, regulation, or order issued thereunder, or any term, condition, or limitation of any license issued thereunder, or for any violation for which a license may be revoked under section 186 of the Act. Any person who willfully violates any provision of the Act or any regulation or order issued thereunder may be guilty of a crime and, upon conviction, may be punished by fine or imprisonment or both, as provided by law.

SCHEDULES

§ 30.70 Schedule A—Exempt concentrations.

Element (atomic number)	Isotope	Column I Gas concentration μCi/ml [1] †	Column II Liquid and solid concentration μCi/ml [2] †
Antimony (51)	Sb 122	.....	3X10⁻⁴
	Sb 124	.....	2X10⁻⁴
	Sb 125	.....	1X10⁻³
Argon (18)	A 37	1X10⁻³	.....
	A 41	4X10⁻⁷	.....
Arsenic (33)	As 73	.....	7X10⁻³
	As 74	.....	5X10⁻⁴
	As 76	.....	2X10⁻⁴
	As 77	.....	8X10⁻⁴
Barium (56)	Ba 131	.....	2X10⁻³
	Ba 140	.....	3X10⁻⁴
Beryllium (4)	Be 7	.....	2X10⁻²
Bismuth (83)	Bi 206	.....	4X10⁻⁴
Bromine (35)	Br 82	4X10⁻⁶	3X10⁻³
Cadmium (48)	Cd 109	.....	2X10⁻³
	Cd 115m	.....	3X10⁻⁴
	Cd 115	.....	3X10⁻³
Calcium (20)	Ca 45	.....	9X10⁻⁴
	Ca 47	.....	5X10⁻⁴
Carbon (6)	C 14	1X10⁻⁶	8X10⁻³
Cerium (58)	Ce 141	.....	9X10⁻⁴
	Ce 143	.....	4X10⁻⁴
	Ce 144	.....	1X10⁻⁴
Cesium (55)	Cs 131	.....	2X10⁻³
	Cs 134m	.....	6X10⁻³
	Cs 134	.....	9X10⁻⁵
Chlorine (17)	Cl 38	9X10⁻⁷	4X10⁻³
Chromium (24)	Cr 51	.....	2X10⁻²
Cobalt (27)	Co 57	.....	6X10⁻⁴
	Co 58	.....	1X10⁻³
	Co 60	.....	5X10⁻⁴
Copper (29)	Cu 64	.....	3X10⁻³
Dysprosium (66)	Dy 165	.....	4X10⁻³
	Dy 166	.....	4X10⁻⁴
Erbium (68)	Er 169	.....	9X10⁻⁴
	Er 171	.....	1X10⁻³
Europium (63)	Eu 152 (T½= 9.2 Hrs)	.....	6X10⁻⁴
	Eu 155	.....	2X10⁻³
Fluorine (9)	F 18	2X10⁻⁵	8X10⁻³
Gadolinium (64)	Gd 153	.....	2X10⁻³
	Gd 159	.....	8X10⁻⁴
Gallium (31)	Ga 72	.....	4X10⁻⁴
Germanium (32)	Ge 71	.....	2X10⁻²
Gold (79)	Au 196	.....	2X10⁻³
	Au 198	.....	5X10⁻⁴
	Au 199	.....	2X10⁻³
Hafnium (72)	Hf 181	.....	7X10⁻⁴
Hydrogen (1)	H 3	1X10⁻³	3X10⁻²
Indium (49)	In 113m	.....	1X10⁻³
	In 114m	.....	2X10⁻⁴
Iodine (53)	I 126	3X10⁻⁹	2X10⁻⁴
	I 131	3X10⁻⁹	2X10⁻⁴
	I 132	8X10⁻⁸	6X10⁻⁴
	I 133	1X10⁻⁸	7X10⁻⁴
	I 134	2X10⁻⁷	1X10⁻³
Iridium (77)	Ir 190	.....	2X10⁻³
	Ir 192	.....	4X10⁻⁴
	Ir 194	.....	3X10⁻⁴
Iron (26)	Fe 55	.....	8X10⁻³
	Fe 59	.....	6X10⁻⁴
Krypton (36)	Kr 85m	1X10⁻⁶	.....
	Kr 85	3X10⁻⁶	.....
Lanthanum (57)	La 140	.....	2X10⁻⁴
Lead (82)	Pb 203	.....	4X10⁻³
Lutetium (71)	Lu 177	.....	1X10⁻³
Manganese (25)	Mn 52	.....	3X10⁻⁴
	Mn 54	.....	1X10⁻³
	Mn 56	.....	1X10⁻³
Mercury (80)	Hg 197m	.....	2X10⁻³
	Hg 197	.....	3X10⁻³
	Hg 203	.....	2X10⁻⁴
Molybdenum (42)	Mo 99	.....	2X10⁻³
Neodymium (60)	Nd 147	.....	6X10⁻⁴
	Nd 149	.....	3X10⁻³
Nickel (28)	Ni 65	.....	1X10⁻³
Niobium (Columbium) (41)	Nb 95	.....	1X10⁻³
	Nb 97	.....	9X10⁻³
Osmium (76)	Os 185	.....	7X10⁻⁴
	Os 191m	.....	3X10⁻²
	Os 191	.....	2X10⁻³
	Os 193	.....	6X10⁻⁴
Palladium (46)	Pd 103	.....	3X10⁻³
	Pd 109	.....	9X10⁻⁴
Phosphorus (15)	P 32	.....	2X10⁻⁴
Platinum (78)	Pt 191	.....	1X10⁻³
	Pt 193m	.....	1X10⁻²
	Pt 197m	.....	1X10⁻²
	Pt 197	.....	1X10⁻³
Potassium (19)	K 42	.....	3X10⁻³
Praseodymium (59)	Pr 142	.....	3X10⁻⁴
	Pr 143	.....	5X10⁻⁴
Promethium (61)	Pm 147	.....	2X10⁻³
	Pm 149	.....	4X10⁻⁴
Rhenium (75)	Re 183	.....	6X10⁻³
	Re 186	.....	9X10⁻⁴
	Re 188	.....	6X10⁻⁴
Rhodium (45)	Rh 103m	.....	1X10⁻¹
	Rh 105	.....	1X10⁻³
Rubidium (37)	Rb 86	.....	7X10⁻⁴
Ruthenium (44)	Ru 97	.....	4X10⁻³
	Ru 103	.....	8X10⁻⁴
	Ru 105	.....	1X10⁻³
	Ru 106	.....	1X10⁻⁴
Samarium (62)	Sm 153	.....	8X10⁻⁴
Scandium (21)	Sc 46	.....	4X10⁻⁴
	Sc 47	.....	9X10⁻⁴
	Sc 48	.....	3X10⁻⁴
Selenium (34)	Se 75	.....	3X10⁻³
Silicon (14)	Si 31	.....	9X10⁻³
Silver (47)	Ag 105	.....	1X10⁻³
	Ag 110m	.....	3X10⁻⁴
	Ag 111	.....	4X10⁻⁴
Sodium (11)	Na 24	.....	2X10⁻³
Strontium (38)	Sr 85 *	.....	1X10⁻³
	Sr 89	.....	1X10⁻⁴
	Sr 91	.....	7X10⁻⁴
	Sr 92	.....	7X10⁻⁴
Sulfur (16)	S 35	9X10⁻⁸	6X10⁻³
Tantalum (73)	Ta 182	.....	4X10⁻⁴
Technetium (43)	Tc 96m	.....	1X10⁻²
	Tc 96	.....	1X10⁻³
Tellurium (52)	Te 125m	.....	2X10⁻³
	Te 127m	.....	6X10⁻⁴
	Te 127	.....	3X10⁻³
	Te 129m	.....	3X10⁻⁴
	Te 131m	.....	6X10⁻⁴
	Te 132	.....	3X10⁻⁴
Terbium (65)	Tb 160	.....	4X10⁻⁴
Thallium (81)	Tl 200	.....	4X10⁻³
	Tl 201	.....	3X10⁻³
	Tl 202	.....	1X10⁻³
	Tl 204	.....	1X10⁻³
Thulium (69)	Tm 170	.....	5X10⁻⁴
	Tm 171	.....	5X10⁻³
Tin (50)	Sn 113	.....	9X10⁻⁴
	Sn 125	.....	2X10⁻⁴
Tungsten (Wolfram) (74)	W 181	.....	4X10⁻³
	W 187	.....	7X10⁻⁴
Vanadium (23)	V 48	.....	3X10⁻⁴
Xenon (54)	Xe 131m	4X10⁻⁶	.....
	Xe 133	3X10⁻⁶	.....
	Xe 135	1X10⁻⁶	.....
Ytterbium (70)	Yb 175	.....	1X10⁻³
Yttrium (39)	Y 90	.....	2X10⁻⁴
	Y 91m	.....	2X10⁻²
	Y 91	.....	3X10⁻⁴
	Y 92	.....	9X10⁻⁴
	Y 93	.....	3X10⁻⁴
Zinc (30)	Zn 65	.....	1X10⁻³
	Zn 69m	.....	7X10⁻⁴
	Zn 69	.....	2X10⁻³
Zirconium (40)	Zr 95	.....	6X10⁻⁴
	Zr 97	.....	2X10⁻⁴
Beta and/or gamma emitting byproduct material not listed above with half-life less than 3 years.	.....	1X10⁻⁹	1X10⁻³

Note 1: Many radioisotopes disintegrate into isotopes which are also radioactive. In expressing the concentrations in Schedule A, the activity stated is that of the parent isotope and takes into account the daughters.

Note 2: For purposes of § 30.14 where there is involved a combination of isotopes, the limit for the combination should be derived as follows:

Determine for each isotope in the product the ratio between the concentration present in the product and the exempt concentration established in Schedule A for the specific isotope when not in combination. The sum of such ratios may not exceed "1" (i.e., unity).

Example:

$$\frac{\text{Concentration of Isotope A in Product}}{\text{Exempt concentration of Isotope A}} + \frac{\text{Concentration of Isotope B in Product}}{\text{Exempt concentration of Isotope B}} \leq 1$$

§ 30.71 Schedule B.

Byproduct material	Microcuries
Antimony 122 (Sb 122)	100
Antimony 124 (Sb 124)	10
Antimony 125 (Sb 125)	10
Arsenic 73 (As 73)	100
Arsenic 74 (As 74)	10
Arsenic 76 (As 76)	10
Arsenic 77 (As 77)	100
Barium 131 (Ba 131)	10
Barium-133 (Ba 133)	10
Barium 140 (Ba 140)	10
Bismuth 210 (Bi 210)	1
Bromine 82 (Br 82)	10
Cadmium 109 (Cd 109)	10
Cadmium 115m (Cd 115m)	10
Cadmium 115 (Cd 115)	100
Calcium 45 (Ca 45)	10
Calcium 47 (Ca 47)	10
Carbon 14 (C 14)	100
Cerium 141 (Ce 141)	100
Cerium 143 (Ce 143)	100
Cerium 144 (Ce 144)	1
Cesium 131 (Cs 131)	1,000
Cesium 134m (Cs 134m)	100
Cesium 134 (Cs 134)	1
Cesium 135 (Cs 135)	10
Cesium 136 (Cs 136)	10
Cesium 137 (Cs 137)	10
Chlorine 36 (Cl 36)	10
Chlorine 38 (Cl 38)	10
Chromium 51 (Cr 51)	1,000
Cobalt 58m (Co 58m)	10
Cobalt 58 (Co 58)	10
Cobalt 60 (Co 60)	1
Copper 64 (Cu 64)	100
Dysprosium 165 (Dy 165)	10
Dysprosium 166 (Dy 166)	100
Erbium 169 (Er 169)	100
Erbium 171 (Er 171)	100
Europium 152 9.2h (Eu 152 9.2h)	100
Europium 152 13 yr (Eu 152 13 yr)	1
Europium 154 (Eu 154)	1
Europium 155 (Eu 155)	10
Fluorine 18 (F 18)	1,000

[1] Values are given only for those materials normally used as gases.

[2] μCi/gm for solids.

† Amended 38 FR 29364.

* Added 35 FR 3982.

** Added 36 FR 16898.

40 FR 3774

30 FR 8195

30 FR 8195

35 FR 6425

30 FR 8195

Byproduct material	Microcuries
Gadolinium 153 (Gd 153)	10
Gadolinium 159 (Gd 159)	100
Gallium 72 (Ga 72)	10
Germanium 71 (Ge 71)	100
Gold 198 (Au 198)	100
Gold 199 (Au 199)	100
Hafnium 181 (Hf 181)	10
Holmium 166 (Ho 166)	100
Hydrogen 3 (H 3)	1,000
Indium 113m (In 113m)	100
Indium 114m (In 114m)	10
Indium 115m (In 115m)	100
Indium 115 (In 115)	10
Iodine 125 (I 125)	1
Iodine 126 (I 126)	1
Iodine 129 (I 129)	0.1
Iodine 131 (I 131)	1
Iodine 132 (I 132)	10
Iodine 133 (I 133)	1
Iodine 134 (I 134)	10
Iodine 135 (I 135)	10
Iridium 192 (Ir 192)	10
Iridium 194 (Ir 194)	100
Iron 55 (Fe 55)	100
Iron 59 (Fe 59)	10
Krypton 85 (Kr 85)	100
Krypton 87 (Kr 87)	10
Lanthanum 140 (La 140)	10
Lutetium 177 (Lu 177)	100
Manganese 52 (Mn 52)	10
Manganese 54 (Mn 54)	10
Manganese 56 (Mn 56)	10
Mercury 197m (Hg 197m)	100
Mercury 197 (Hg 197)	100
Mercury 203 (Hg 203)	10
Molybdenum 99 (Mo 99)	100
Neodymium 147 (Nd 147)	100
Neodymium 149 (Nd 149)	100
Nickel 59 (Ni 59)	100
Nickel 63 (Ni 63)	10
Nickel 65 (Ni 65)	100
Niobium 93m (Nb 93m)	10
Niobium 95 (Nb 95)	10
Niobium 97 (Nb 97)	10
Osmium 185 (Os 185)	10
Osmium 191m (Os 191m)	100
Osmium 191 (Os 191)	100
Osmium 193 (Os 193)	100
Palladium 103 (Pd 103)	100
Palladium 109 (Pd 109)	100
Phosphorus 32 (P 32)	10
Platinum 191 (Pt 191)	100
Platinum 193m (Pt 193m)	100
Platinum 193 (Pt 193)	100
Platinum 197m (Pt 197m)	100
Platinum 197 (Pt 197)	100
Polonium 210 (Po 210)	0.1
Potassium 42 (K 42)	10
Praseodymium 142 (Pr 142)	100
Praseodymium 143 (Pr 143)	100
Promethium 147 (Pm 147)	10
Promethium 149 (Pm 149)	10
Rhenium 186 (Re 186)	100
Rhenium 188 (Re 188)	100
Rhodium 103m (Rh 103m)	100
Rhodium 105 (Rh 105)	100
Rubidium 86 (Rb 86)	10
Rubidium 87 (Rb 87)	10
Ruthenium 97 (Ru 97)	100
Ruthenium 103 (Ru 103)	10
Ruthenium 105 (Ru 105)	10
Ruthenium 106 (Ru 106)	1
Samarium 151 (Sm 151)	10
Samarium 153 (Sm 153)	100
Scandium 46 (Sc 46)	10
Scandium 47 (Sc 47)	100
Scandium 48 (Sc 48)	10
Selenium 75 (Se 75)	10
Silicon 31 (Si 31)	100
Silver 105 (Ag 105)	10
Silver 110m (Ag 110m)	1
Silver 111 (Ag 111)	100

Byproduct material	Microcuries
Sodium 24 (Na 24)	10
Strontium 85 (Sr 85)	10
Strontium 89 (Sr 89)	1
Strontium 90 (Sr 90)	0.1
Strontium 91 (Sr 91)	10
Strontium 92 (Sr 92)	10
Sulphur 35 (S 35)	100
Tantalum 182 (Ta 182)	10
Technetium 96 (Tc 96)	10
Technetium 97m (Tc 97m)	100
Technetium 97 (Tc 97)	100
Technetium 99m (Tc 99m)	100
Technetium 99 (Tc 99)	10
Tellurium 125m (Te 125m)	10
Tellurium 127m (Te 127m)	10
Tellurium 127 (Te 127)	100
Tellurium 129m (Te 129m)	10
Tellurium 129 (Te 129)	100
Tellurium 131m (Te 131m)	10
Tellurium 132 (Te 132)	10
Terbium 160 (Tb 160)	10
Thallium 200 (Tl 200)	100
Thallium 201 (Tl 201)	100
Thallium 202 (Tl 202)	100
Thallium 204 (Tl 204)	10
Thulium 170 (Tm 170)	10
Thulium 171 (Tm 171)	10
Tin 113 (Sn 113)	10
Tin 125 (Sn 125)	10
Tungsten 181 (W 181)	10
Tungsten 185 (W 185)	10
Tungsten 187 (W 187)	100
Vanadium 48 (V 48)	10
Xenon 131m (Xe 131m)	1,000
Xenon 133 (Xe 133)	100
Xenon 135 (Xe 135)	100
Ytterbium 175 (Yb 175)	100
Yttrium 90 (Y 90)	10
Yttrium 91 (Y 91)	10
Yttrium 92 (Y 92)	100
Yttrium 93 (Y 93)	100
Zinc 65 (Zn 65)	10
Zinc 69m (Zn 69m)	100
Zinc 69 (Zn 69)	1,000
Zirconium 93 (Zr 93)	10
Zirconium 95 (Zr 95)	10
Zirconium 97 (Zr 97)	10
Any byproduct material not listed above other than alpha emitting byproduct material	0.1

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